August 29, 1960

Aviation Week and Space Technology

75 Cents

A McGraw-Hill Publication

T-38 Pilot Report

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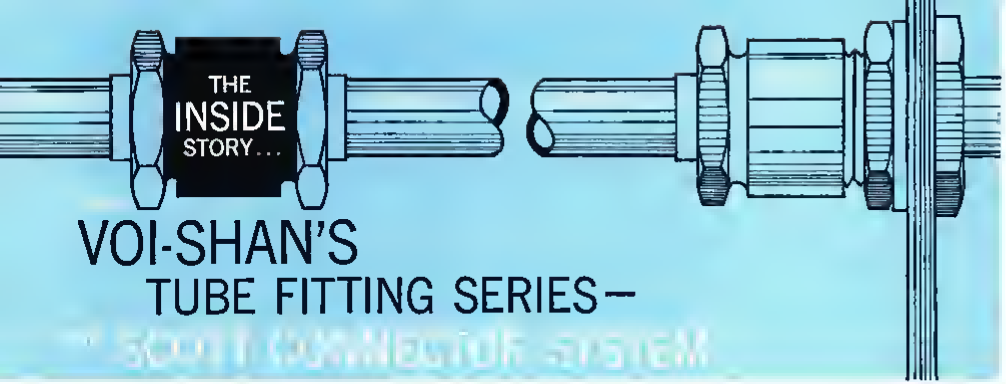
Able Star Design

Jet Ground Handling
At Idlewild Airport



VOI-SHAN'S TUBE FITTING SERIES—

SCOTT CONNECTOR SYSTEM

Voi-Shan's introduction of the Scott Connector System made available for the first time a highly versatile standard tube-connecting envelope, adaptable to all types of tubing connections together with the added ability to perform multiple functions. Standardization of this type and on this scale had never been attempted before.

The Scott Connector System provides fluid systems designers with such significant assets as:

1. Simple weight savings of up to 75%
2. Greatly reduced mass
3. Flared, flareless or beaded-tubing installations using the same exterior envelope
4. Incorporation of check valves, reducers and other devices as part of the connector's function without changing the envelope
5. Ready adaptability to titanium and other super alloys
6. Very high systems end cost savings
7. Reduction of human-error factor in installation

Refinement of the "plumbing" art in aircraft construction had lagged considerably behind other structural advances until the advent of the Scott Connector System. The old flared and flareless "heavies" were fine twenty years ago but today their inefficiency in weight, bulk and restricted function are outdated. Who has not pondered the problems of routing motor-fluid, fuel and air systems through a present-day structure, fighting for every bit of space, while watching the weight factor? Answers to such all too common problems were the basis of the Scott Connector System. The inventor, William James Scott, is today a valued member of Voi-Shan's engineering staff. Earlier, however, for a long time he worked with these problems at the boards and arrived at a design solution. Two solid years of engineering effort at Voi-Shan have proved his ideas right.

The simplicity of the Scott Connector System disguises the strength and versatility that are only apparent on closer examination. For example, the system is rated for working pressures of 3,000 psi in both flared and flareless versions, using *2024T6 aluminum* with proof pressures of 6 000 psi and 12,000 psi burst pressure, consistent with the performance requirements of Mil-F-18280. The arduous impulse-vibration requirements of this specification are comfortably exceeded by the flareless version. In addition, transition from flared to flareless-type connection or vice-versa is simply made by changing the connector insert, the outer envelope, consisting of nut and coupling, remains the same. Similarly, for beaded-tube connections—one simply changes the insert. To install a check-valve, a restrictor or a reducer is quite easy—the insert performs a double duty!

Concern about cross-threading or insert misalignment during installation is eliminated by the Scott Connector System. A pilot device on the envelope nut prevents cross-threading and a special land on any insert assures perfect alignment. Correct direction of flow in installing or replacing a check-valve is guaranteed—if it is put in incorrectly the connection cannot be made.

Weight-savings is usually the result of clever design and the Scott Connector System is no exception. The statement above, that a *simple* weight-saving of up to 75% can be realized, means that up to a 75% weight-saving occurs as a *direct* result of the Scott design.

Mass is often a problem in aircraft structure. It aggravates and multiplies fatigue stresses due to local oscillatory effects, and since mass is usually associated with volume, the further problem of location is presented. In modern aircraft this usually means *inside* something, especially since the aerodynamicists object to the hanging of components on the *outside* of the airplane, although unfortunately that is often the only place where space is available. The Scott Connector is very compact. It will satisfy the aerodynamicist as well as electrical and control systems engineers.

With military purse strings (and company ones, too) tighter than ever, "cost" is always a consideration. The Scott Connector is not cheap, however, it is inexpensive. The Scott System saves money through simplified inventory, easier installation, and versatility plus a relatively low prime cost.

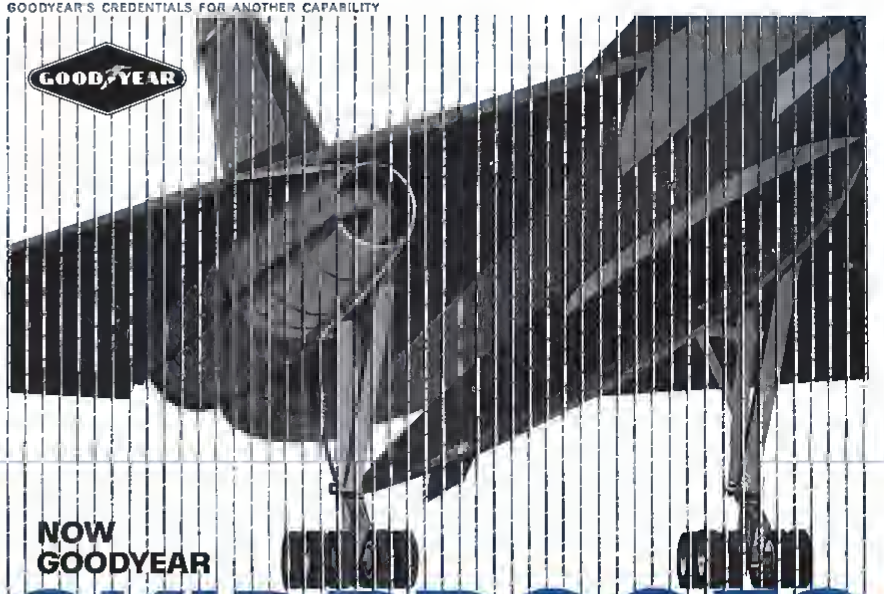
Voi-Shan's Scott Connector System is available in aluminum, stainless steel and titanium alloy in flared, flareless and flexible versions. If super-high-performance is required (for 4,000 psi systems), an extra-high-strength insert alone will accommodate the requirement. The connectors are available in standard and bulkhead configurations and all standard line sizes are available.

Discover more of the tremendous advantages of the versatile Scott Connector System. Write on your letterhead or use the coupon below indicating any special area of interest with which you may be concerned.

Please send your technical brochure on Voi-Shan's Tube Fitting Series—The Scott Connector System

VOI-SHAN MANUFACTURING COMPANY
A Division of Voi-Shan Industries, Inc.
3463 HIGUERA STREET, CULVER CITY, CALIFORNIA

GOODYEAR'S CREDENTIALS FOR ANOTHER CAPABILITY



NOW GOODYEAR

SKIDPROOFS

THE 16 MAINWHEEL TIRES ON THE B-58

To protect the hustling B-58 bomber against skid hazard, Goodyear engineered a lightweight (9¾ lbs!) system that acts *automatically* to prevent skids *before* they start.

With high landing speeds common today, the need for positive, reliable skid protection is now critical. Goodyear anti-skid systems rate preference because they're tailored to the operational characteristics of each aircraft—they're neither "shelf" items nor makeshift gadgets hastily cobbled up from miscellaneous parts.

Here's a sampling of the broad range of planes whose builders insist on Goodyear's "engineered" approach to skid protection:

Republic F-105—Special anti-skid system with close electrical tolerance to prevent skids without responding to or increasing normal gear vibration.

Lockheed F-104 Drone—Goodyear system for ground controlled drone automatically controls braking pressure.

Panagra DC-7B—Increased landing speed at high altitude fields extends landing run. Skid-warning system "buzzes" pilot's foot when skid impends.

Lockheed F-104G—Key factor in designing anti-skid system for this interceptor; maintain minimum stopping distance.

Lockheed JetStar—This corporate transport must also utilize small-town airports—making short landing run main factor in system design.

USAF SC-54—An automatic anti skid system is geared to cover the full scope of world-wide runway operating conditions for this air-sea rescue aircraft.

For details on Goodyear skid-protection systems, write on company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. T-1715, Akron 16, Ohio. Remember—lots of good things come from Goodyear.

One of these systems can skidproof your plane

Skid Warning System* instantly "buzzes" pilot's foot when skid threatens. Pilot corrects for skid retains control.

Anti-Skid System releases brake pressure automatically until skid danger is past. Then it reapplies brake pressure.

Pilot-Modulated System combines first two types. Provides automatic protection yet permits pilot control when desired.

New Adaptive Brake Pressure Control maintains highest usable pressure below skid point regardless of runway conditions.

*Patents Pending

AVIATION PRODUCTS BY GOODYEAR

More Aircraft Land on Goodyear Tires, Wheels, and Brakes Than on Any Other Kind

AVIATION CALENDAR

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors Farnborough

Sept. 7-9—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 8-9—1960 Engine and Operations Symposium, Aerojet Corp., Millville, N. J.

Sept. 8-10—1960 National Convention, OX-5 Club of America, Tower Hotel, Courts, Dallas, Tex.

Sept. 12-13—Sixth Annual Titanium Metallurgy Conference, New York University's College of Engineering, Bronx, N. Y.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland

Sept. 12-16—First Annual USAF Safety Congress, Mission Inn, Riverside, Calif., Sponsor, Office of the Deputy Inspector General for Safety, USAF, Norton AFB

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton Park Hotel, Washington, D. C.

Sept. 15-16—Eighth Annual Engineering Management Conference, Morrison Hotel, Chicago, Ill.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, IRE, Shoreham Hotel, Washington, D. C.

Sept. 20-22—13th Annual Meeting & Forum, National Business Aircraft Assn., Ambassador Hotel, Los Angeles, Calif.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

(Continued on page 6)

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AVIATION CALENDAR

(Continued from page 5)

Sept. 24—Reunion 1st Air Commando Group concurrent with AFA Convention. Contact Lt. Col. R. E. Morse, USAF, 7025 Havenhurst Ave., Van Nuys, Calif.

Sept. 25-27—24th Annual Convention International Northwest Aviation Council, Harrison Hot Springs, British Columbia.

Sept. 27-30—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif.

Oct. 2-10—Federation Aeronautique Internationale Annual Meeting, Barcelona.

Oct. 3-5—Sixth National Communications Symposium, Institute of Radio Engineers, Utica, N. Y.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton Palace Hotel, San Francisco, Calif.

Oct. 4-6—Sixth Conference on Radio Interference Reduction, Chicago, Ill. Sponsors: Armour Research Foundation, U. S. Army, U. S. Navy; USAF, Institute of Radio Engineers' Professional Group on Radio Frequency Interference.

Oct. 5-7—Briefing Session on Opportunities in Space Age Technology, American Management Assn., Hotel Astor, New York, N. Y.

Oct. 6-8—Annual Convention, Airmail Pioneers, El Cortez Hotel, San Diego, Calif.

Oct. 6-8—Society of Experimental Test Pilots Symposium on "Omni-some Flight," Ambassador Hotel, Los Angeles, Calif. Fourth Annual Awards Banquet, Oct. 8.

Oct. 6-9—Annual Meeting, National Pilots Assn., Western Hills Lodge, Wagoner.

Oct. 8—Third Annual National Aero Club Football Flyin, Michigan vs. Duke, Ann Arbor, Mich.

Oct. 10-12—1960 National Electronics Conference and Exhibition, Hotel Sherman, Chicago, Ill.

Oct. 10-14—Society of Automotive Engineers National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Calif.

Oct. 14-15—Symposium on High-Speed Processing, Society of Photographic Scientists & Engineers, Washington, D. C.

Oct. 14-15—15th Midwest Conference, American Society for Quality Control, Broadview Hotel, Wichita, Kan.

Oct. 17-18—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Canada.

Oct. 19-21—Annual Convention, Southeastern Airport Managers' Assn., Far Horizons Motel, Sarasota-Bradenton, Fla.

Oct. 19-21—Symposium on Space Navigation, Institute of Radio Engineers, Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 20-21—National Symposium on Hypervelocity Techniques, Institute of the Aeronautical Sciences, Shirley-Savoy Hotel, Denver, Colo.

around
the world
in 100 minutes

. . . a problem in navigation and guidance

Behind that storied global traveler Phineas Fogg was his valet and navigator Passepartout. Tomorrow's space "Phineas Foggs" will depend on a sophisticated electronic Passepartout to guide their vehicles to the fringe of space and return—in 100 minutes.

Arma is ready for that era. As developer and producer of the first all-inertial guidance system for Air Force ICBMs, Arma has the knowledge, facilities and people to meet the challenge of navigating a manned glider in near space.

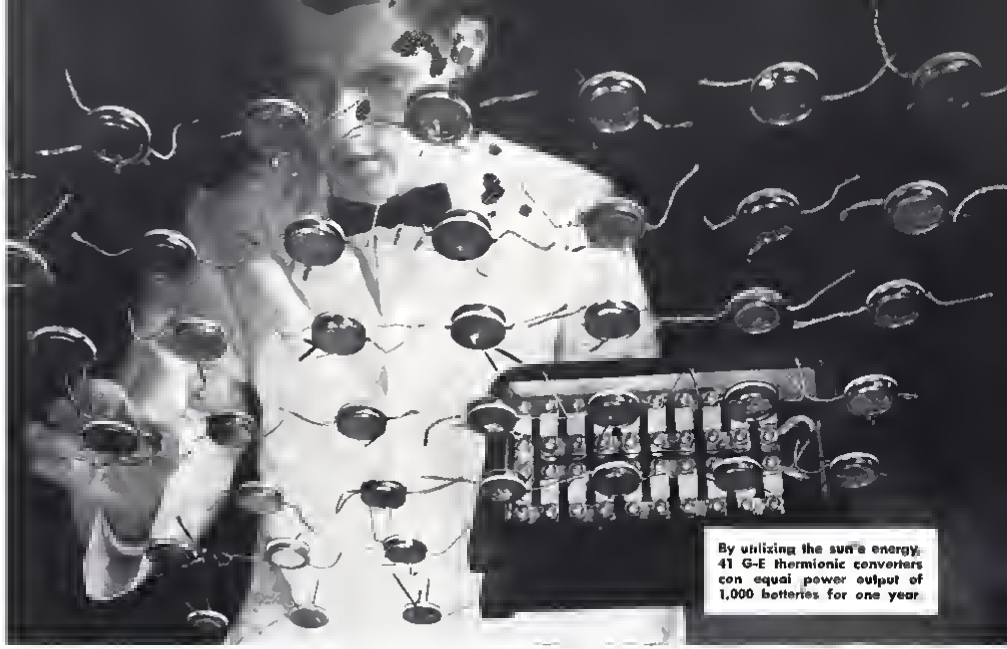
Inertial guidance offers important advantages: self-containment . . . low cost . . . immunity to communications failure . . . positive position calculation . . . no time lag in making course corrections . . . a minimum of ground support equipment.

Arma is developing smaller and better inertial systems for use in the years ahead that employ submminature computers, low threshold accelerometers, gyros suspended in liquid metal and other advanced techniques in inertial instrumentation.

ARMA, Garden City, New York, a division of American Bosch Arma Corporation . . . the future is our business.

Engineers, Write to E. C. Lester at ARMA about career R&D opportunities.

AMERICAN BOSCH ARMA CORPORATION



MISSILE AND SPACE VEHICLE DEPARTMENT

...center for missile and space technology research and development at General Electric

Progress in power for space

Manned space flights, as well as other U S space projects, will require new, light-weight, long-life sources of electrical energy. Conventional batteries, now being used in missiles and satellites, are far too heavy for most future space applications.

For example, during a year's operation, one thousand 15 amp/hr batteries, similar to the one shown above, would be required to equal the 41 watts which the thermionic converters in the photo can generate from the heat of the sun. These batteries would weigh 15,000 lbs—a complete thermionic system, including the converters developed in General Electric's Research Laboratory plus a collector and orientation equipment, only about 20 lbs.

To provide such new, light-weight systems, engineers at General Electric's Missile and Space Vehicle Department are investigating a wide variety of promising space power sources, utilizing the specialized capabilities of other Company research operations. For instance, under U.S. Air Force contract, G E is conducting extensive research in thermionics, and is developing an experimental thermionic system consisting of a solar collector, converters, and storage and control components. Intensive work in photovoltaics includes the development of an advanced unit to provide more than 500 watts of continuous power for the Advent communications satellite.

For the U S. Army Signal Research and Development Laboratory, a regenerative fuel cell is under development, as are magnetohydrodynamic electrical converters for the Air Force Office of Scientific Research, WADD and BMD. In addition, MSVD is investigating nuclear thermionics and nuclear turbines.

To learn more about these MSVD space power developments, write to Section 160-76, General Electric Co., Missile and Space Vehicle Department, Philadelphia 1, Penna. 160-76

GENERAL ELECTRIC

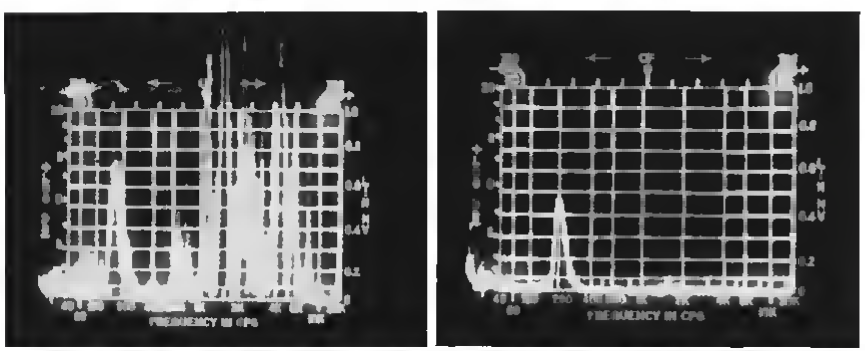
MISSILE AND SPACE VEHICLE DEPARTMENT

A Department of the Defense Electronics Division

Scientists and Engineers interested in career opportunities in Space Technology, contact Mr. T. H. Sebring, Dept. 160, MSVD

New Honeywell Gas Bearing Gyro Greatly Improves Reliability, Performance

Combining advanced production techniques with a revolutionary design concept, Honeywell engineers have produced a miniature floated integrating gyroscope which uses a self-pressurizing film of gas in place of ball bearings. This new gyro will operate without failure for years, while giving measurements many times more accurate than the best conventional floated gyros.



These unretouched photos show noise reduction accomplished by Honeywell's new gas bearing gyro. Bearing noise gives an accurate indication of bearing uncertainties. Photo at left shows screen of a panoramic sonic analyzer displaying the output from acceleration type pickoffs attached to conventional inertial grade floated gyro (GG49) spin motor mount. Photo at right shows same set up operating at same gain, displaying noise output from spin motor mount of this new gyro. Noise reduction is about 30 to 1.

Five years of research and engineering effort at Honeywell have culminated in the successful development, test and production of the first miniature floated rate integrating gyro with gas bearing spin motor. Even the finest ball bearing spin motor suspension places limitations on gyro life and performance. In Honeywell's new gas bearing MIG the conventional ball bearing spin motor has been replaced with a completely new gas bearing spin motor. Tests show that the new gyro will operate reliably for years instead of months, while performing many times as well as existing gyros.

Although the sole purpose of a gyroscope is to measure angular motion, existing gyros also respond to vibration and to other phenomena such as changes in temperature and pressure. These variables produce unwanted torques that interfere with the true angular motion torque signal. For systems requiring great accuracy, the need to reduce these torques has become more urgent than ever.

Two kinds of unwanted torques present the most serious obstacles to gyro accuracy. These are *friction* torque, which masks some of the lower level true gyroscopic torque and thereby limits the threshold capability of the gyro—and *unbalance* torque, which appears as angular motion or drift.

The development of floated gimbals greatly reduced the problem presented by friction torque. For example, flotation of more than 99% of the gimbal weight has now reduced friction to about 0.001 dyne-centimeters.

Unbalance torques are most often associated with the spin motor and spin motor bearings. There are four primary areas to which the gas bearing gyro offers appreciable advantages in minimizing the following uncertainties:

1. Torques resulting from mechanical rectifications of vibrations set up throughout the bearing.
2. Torques resulting from movement of the ball retainers and shifts of balls in the raceway.
3. Mechanical hysteresis resulting from material damping and ball slippage.
4. Deformations resulting from stresses imposed on the balls by various motions of the gyro.

To the extent that these torques are regular and, within a given gyro, repeatable, it is possible to balance them out by trim adjustments. But there still remain some that cannot be compensated for because they are inconsistent. These are the torques that establish the true uncertainty level of the gyro and set its drift pattern. It is in improved control of these torques that the gas bearing spin motor has made its remarkable contribution.

The gas bearing eliminates the balls and retainers, substitutes viscous damping for hysteresis damping, and reduces to near zero, deformations resulting from thermal expansion. With this new spin motor, bearing noise is reduced by a ratio of 30 to 1, as shown in the unretouched photographic records of the sonic analysis on the page at left.

The development of a miniature gas bearing spin motor to be housed in a gimbal as small as that of the Honeywell MIG was no simple task of scaling down a larger gas bearing motor. Gas does not exhibit the thin film lubricant properties of oil and it will serve as an adequate bearing lubricant only if the bearing geometry is proper. A gas bearing depends upon viscous shear which drags the gas down a narrow passageway where it is squeezed through a wedge shaped area. As the gas is squeezed, its pressure increases so that it will support a load. In the journal bearing, the load automatically produces the "wedge" area.

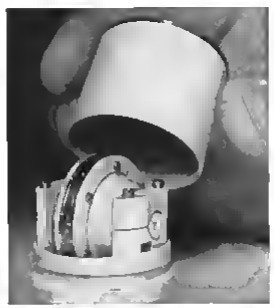
While the gas bearing spin motor is running, there is no contact of the bearing elements, and wear is virtually eliminated. However, there is some surface-to-surface contact on starting and stopping, and for this reason great care had to be taken in the choice and development of the material. The critical factors were dimensional stability, hardness, stiffness and cleanability. Honeywell engineers worked out a solution that has resulted in a gyro that shows no measurable wear after several thousand starts and stops.

Honeywell has accomplished a major breakthrough with the development of the miniaturized ceramic spin motor and shaft. The extreme hardness of this new material requires that it be finished with special diamond tooling. This new ceramic material has great dimensional stability over a wide temperature range and throughout a long life. The ceramic is extremely stiff—another advantage, particularly for a bearing shaft.

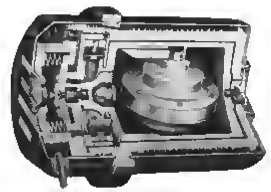
The stability of this new ceramic also makes it more attractive than metals for use in other parts of the gyro such as the gimbal, the coil cup, and the encapsulation for the stator.

Contamination has always been critical in the manufacture of floated gyros. With extremely small clearances in the gas bearing spin motor, a one micron dust particle (39.37 millionths) cannot be tolerated. Ceramic parts can be cleaned with an acid which dissolves everything but the ceramic, allowing improved production cleaning and assembly techniques.

The GG124 will have far-reaching applications. It is a logical outgrowth of Honeywell's scientific and technical strength, its systems engineering, and its ability to complete the cycle from research through production quickly and effectively. Write Minneapolis-Honeywell Dept. AW 8-158, 2600 Ridgway Rd., Minneapolis 13, Minnesota.



Ceramic Gimbal and spin motor of Honeywell's new GG124 Gas Bearing Gyro. Extreme hardness, great dimensional stability, and stiffness of this new ceramic material permits gyro to operate for years without failure while performing many times better than conventional gyros.



Cutaway drawing of Honeywell's new GG124 Gas Bearing MIG. The ceramic spin motor is located in the floated ceramic gimbal at right. Running at 24,000 RPM, the spin motor is suspended on a self contained film of gas less than 50 millionths of an inch thick. The GG124 weighs 8 ounces and measures 2.8" long by 1.8" in diameter.

Engineers and Scientists

Explore the professional opportunities at Honeywell. See page 109

Honeywell

Military Products Group

Meet the newest
member of the Sabre family

The T-39 Sabreliner is the Air Force's first twin-jet utility trainer. Now in production, it carries on the heritage of North American Aviation's renowned Sabre aircraft—the F-86 Sabre Jet and the F-100 Super Sabre.

Designed and built by North American for the Air Force, the versatile Sabreliner now is undergoing FAA certification that not only meets all military requirements but also civil specifications.

An important consideration in designing the Sabreliner was economy of operation. The result is a highly practical airplane not only when flying, but also during servicing and maintenance.

A wide range of capabilities makes the Sabreliner a highly versatile and hard-working member of today's Air Force. Carrying four students and a crew of two, it functions as a radar, navigation, or jet-proficiency trainer.

In performance, the Sabreliner rivals commercial jet airliners. Two Pratt and Whitney J-60 (JT-12) engines, with a thrust of 3000 pounds apiece, give it a cruising speed of 500 miles an hour at 40,000 feet, well above most weather. It can fly 1500 nautical miles without refueling, and can land or take off at the airport of almost any city.

With its wide range of capabilities, high performance, and low cost of operation, the T-39 Sabreliner promises to be the Air Force's compact workhorse of the jet age.

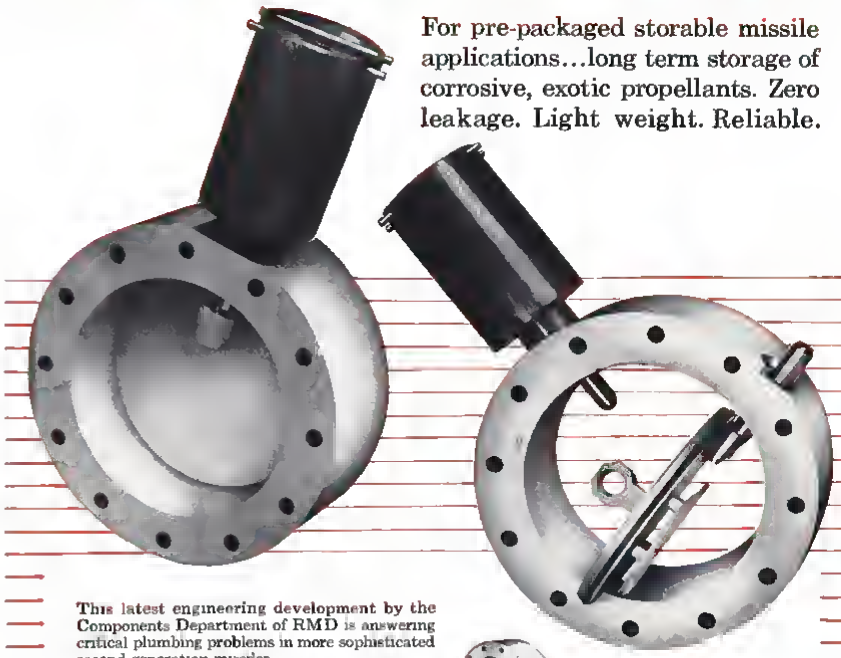
THE LOS ANGELES DIVISION OF NORTH AMERICAN AVIATION, INC.

THE T-39 SABRELINER

New! From the Reaction Motors Division of THIOKOL

HERMETIC BARRIER VALVES

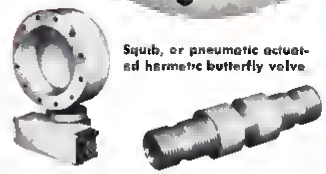
For pre-packaged storable missile applications...long term storage of corrosive, exotic propellants. Zero leakage. Light weight. Reliable.



This latest engineering development by the Components Department of RMD is answering critical plumbing problems in more sophisticated second generation missiles.

Hermetic barrier valves combine metallic sealing capabilities of burst disc with low pressure drop of butterfly valves. They are designed for use with storable propellents—cryogenics such as hydrogen, fluorine and other hard-to-handle fluids.

Propellant pressure actuates these valves which are flow driven to full open position. Squib powered and solenoid-triggered types are also available. Sizes 1½" to 10". Reclosure handled manually or remote with elastomeric seal. Hermetic butterfly eliminates all chance of free particles entering propellant stream.



Squib, or pneumatic actuated hermetic butterfly valve

BREAKAWAY TYPE DISCONNECT VALVE. External leakage of propellent prevented by hermetic seal when connected. Zero leakage after disconnect. (In ½" to 8" sizes.)

For full information, contact Sales Manager, Components Dept.

Thiokol®
CHEMICAL CORPORATION
Reaction Motors Division
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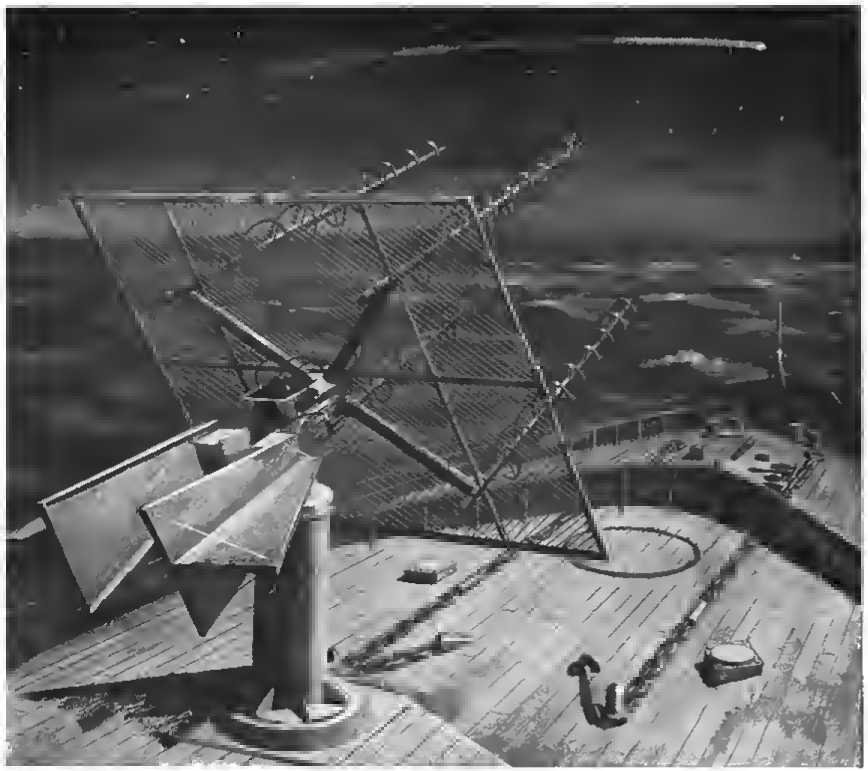
PATENT PENDING



2-week delivery of Cubic AGAVE for shipboard use steps up Atlantic Missile Range tracking

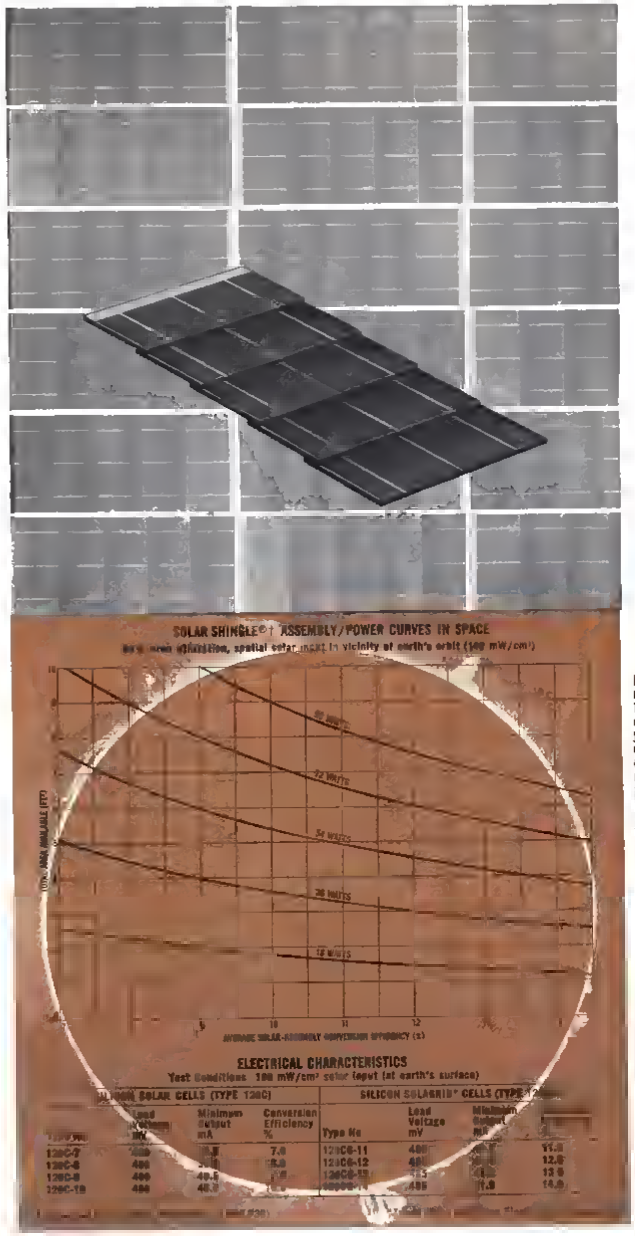
Faster, more accurate location of ICBM nosecones as they re-enter the earth's atmosphere and rush toward impact areas in the South Atlantic will now be possible with a new Cubic AGAVE installation. The system was ready for shipment only two weeks after the initial order was placed. Speed like this typifies Cubic's versatility and flexibility to meet fast changing missile range instrumentation requirements.

This new AGAVE is already installed aboard the American Mariner, a range instrumentation ship operated by RCA. AGAVE (Automatic Gimballed-Antenna Vectoring Equipment) is an automatic tracking antenna system that operates in the 225-mc to 300-mc band. Continuous-wave correlation detection, and the 18-db gain of the antenna array, permit reliable tracking over long ranges.

AGAVE's wide 20° antenna beamwidth can locate the target with only crude initial pointing or coarse scanning. Once the signal is acquired, the automatic tracking feature maintains the antenna boresight on target. After lock-on, azimuth and elevation data can be fed from AGAVE to narrow-beam antennas or optical devices to enable them to find and stay on the target as it hurtles across the sky.

Write for a free booklet on AGAVE, to Dept. AW-1, Cubic Corporation, San Diego 11, California.

cubic



ONLY HOFFMAN GIVES YOU THIS MUCH DESIGN RANGE IN SILICON SOLAR-POWER ASSEMBLIES

No longer need unconventional solar-power requirements cause procurement problems. Hoffman's broad range of conversion efficiencies—widest in the industry—helps you achieve the optimum solution. Now you can specify size, shape, power output and conversion efficiency in an unprecedented number of combinations. ■ The curves at the left show you how much design flexibility is possible. To determine the minimum assembly efficiency necessary, relate the area available to the desired power output. For details, consult your Hoffman sales engineer or request Data Sheet 126 660S.

Hoffman

ELECTRONICS CORPORATION

Semiconductor Division

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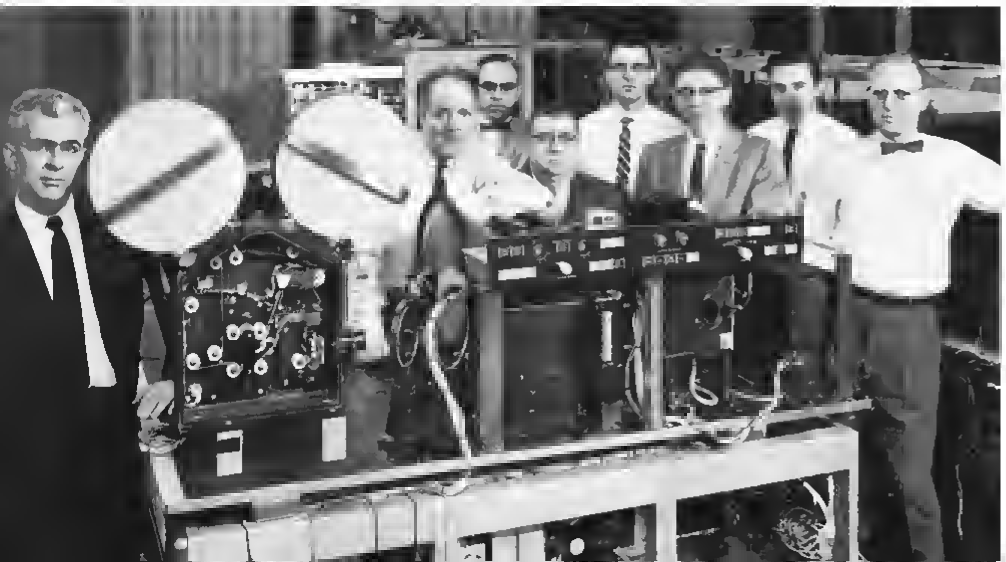
Kodak
TRADE MARK

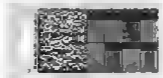
32 years ago Kodak got its start in the data handling field

Kodak didn't really get started in making salable systems for data processing and handling until 1928. There were no magnetic tapes in those days, but long strips of film did prove handy for helping banks keep track of checks. The machine we built for doing this was the Recordak Model 1 microfilming machine; one is pictured on the right.

Except for when the banks took a short rest around March, 1933, this machine and its vastly more talented descendants have been serving the banks ever since. Approaching half a trillion in business documents handled for banks and almost every other enterprise, they have gone far beyond mere record-keeping. They have graduated to automatic look-up, continuous updating of directories, and even the training of human beings.

Today Kodak's Apparatus and Optical Division is *a force in being* that mates advanced microfilming techniques with sophisticated computer gear. Below is a picture of one such issue of this marriage, and the engineers who created it. This device will ingest a computer tape or search the computer's memory, obtain instructions on how to draw letters and numerals from a character-generating device, and put perfect, unfuzzy characters directly on microfilm at a frightening rate.





Here is a picture of a little ship of film, small as it actually is. Notice that it contains a hole, plus some digital data and some tiny photographs. These three parts play a significant role in an automatic library that handles both abstract ideas and pictures, cross-references everything, and responds to the most complicated questions by delivering text, charts, maps, photographs, and documents in a form that a man can read in bed, security regulations permitting. The chaps below are the Kodak *force in being* that created this library system. The little ships of film, of course, are never touched by human hands. It's largely a pushbutton operation. Users find it worth every kilobuck.

Yes, we know how to force photography to make significant sense for storing and working with digital and analog data. Have you heard about the photographic plate* that can store the multimillion bit program of instructions for arranging a nation's telephone long-distance lines to handle the Mother's Day traffic?

*It costs $3, before exposure

←↑ The system on the left is called "Dacom" and the one above is called "Minicard." Information about them is supplied by Recordak Corporation, 415 Madison Avenue, New York 17, N. Y. (Subsidiary of Eastman Kodak Company.) We are not trying to advertise them here. They are merely disclosable examples of what Kodak does in conceiving and building apparatus on the present borders of feasible technology.

Shall we meet and talk of the connection between our capabilities and your problems?

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COVER American Airlines Boeing 707-120 jet transport nears departure time at new American terminal at Idlewild. When the engines are started but still at idle, tug will push aircraft away from the gate. External power and cabin starter trucks are the other units of ramp equipment in picture. The power truck's presence illustrates shakedown problems of the new jet terminals: normally power is supplied by built-in facilities at the gates. But gate shown is the most heavily used and power outlet was temporarily out of service for starter replacement. Engine start is frequently accomplished by air bottle instead of start truck.

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Gates Reviews Defense Policy

Current world tensions and the election campaign have focused unusually strong attention on the state of U. S. defenses. Defense Secretary Thomas S. Gates, Jr., outlined his views on the nation's military strength last week at the national convention of the Veterans of Foreign Wars. Since his evaluation reflects the position of the Administration in the debate on defense policy, AVIATION WEEK presents significant excerpts from his discussion.

We contend with ever changing circumstances—we can no longer safely develop our defense programs once a year. We must constantly review and change them whenever necessary, always exercising good judgment. The best brains of America and the devoted concentration of Congress, the press, the military and our citizens are required if the proper balance is to be achieved and maintained. No issue in American life has been more thoroughly debated than that of defense. It is not without significance that during the current session of Congress the hard working and well informed members of the appropriate committees, in their judgment of the sums needed, came within 1.5% of our own recommendations.

Money is, of course, important but the amount at any given moment only reflects decisions which must themselves respond to change. The needs of our national security must always come first. We have spent and will continue to spend whatever sums are needed in support of a foreign policy backed by great military strength.

There are two central questions that any Secretary of Defense must live with. First, have the policies that guide our defense programs been soundly conceived and competently executed? Second, what guidance do they supply from this point on?

Looking back across my seven years in the Pentagon, I am struck by the fact that the broad outlines of our national objectives and the military policies designed to further them have not greatly changed during that time. This is not to say, however, that the national means have remained as they were. New and revolutionary weapon systems have emerged, and they have given rise to radically new military concepts. But these have been fitted to policy, and policy was prepared for them.

The idea of defense for the long pull grew in the minds of certain of our World War II leaders who foresaw the true character of the USSR. No one saw more clearly what was making up than did one of our greatest men, the late Secretary James Forrestal. In December, 1950, only two weeks after Communist China entered the Korean War, another distinguished and honored predecessor in the Defense Department, the late Gen. Marshall, also perceived what was coming. In a prophetic statement, he warned us that "a trial of endurance" had begun. The experience would be "new to the American people," and the "intensity" of the mobilization then under way would accordingly be governed by the realization that the effort would have to be sustained through "possible years of tension."

This new concept however, was a long time penetrating the then-existing military policies. Two years later, planning in the military services was still tied to the old D-Day concept—a bending of effort toward achieving a condition of maximum readiness on a hypothetical date when the preparations of the adversary might approach a climax. This approach tended to generate artificial requirements and a false peaking of effort. As each successive D-Day approached, it had to be arbitrarily pushed forward to a later date with consequent disturbances and instabilities in defense plans and operations.

It then fell to another soldier-statesman, Dwight D. Eisenhower, to harmonize the policy and the practice. In April, 1953, after some three months in the Presidency, he placed into effect the long-pull strategy that became known as the "New Look" in the national military posture. The D-Day concept was being abandoned as the regulator of planning. In its place, the President was installing a policy designed to provide what he described as "adequate protection to be projected as far into the future as the actions and apparent purposes of others may compel us." It was to be a durable policy, one the nation could live with, as he put it, "over a period of years."

How well has this policy been carried out? How good are the forces? In the judgment of the President, in the judgment of the Joint Chiefs of Staff and in my judgment, the armed forces of the United States are equal to the historic task which confronts them. This strength is real. It should inspire confidence in all our citizens and our friends abroad.

In fact, confidence in our armed forces is in itself the most important element of strength of the free world. It secures the prestige and dignity of our military stature. Let us be extremely careful that that confidence is not undermined by unjustifiable criticism. Constructive criticism of our methods is helpful and essential to the improvement of our defense program, but this should be within the boundaries understanding and belief that our defenses are strong and will be able to meet our heavy responsibilities. The determination of the free world to resist communism rests in large measure upon a shared confidence in the armed might of the United States.

And, most importantly, we must not inadvertently create a false impression of weakness that could induce a communist miscalculation or adventure in aggression.

One reason the forces are superb is that the Defense Department has been constantly reshaping forces and programs to take full advantage of the new technologies. The changes, as you well know, have been deep. But none has been so dramatic as the joining of the nuclear warhead and the ballistic missile. The Air Force's first-generation Atlas and Titan intercontinental ballistic missiles have already been overtaken by much improved versions of the same species. They will be overtaken in turn by the Air Force's Minuteman solid-fuel ICBM, a more versatile weapon of equally great range.

The Navy has in the meantime married its Polaris solid-fuel missile to the deep-cruising nuclear submarine, to produce an utterly novel weapon system of immense significance. Polaris is the newest strategic system to enter the U. S. order of battle. It has fired the imagination of all who study it.

I shall not dwell on the other retaliatory forces. You know them well. Their effectiveness is being increased. We are moving toward a faster reaction time, a wider dispersal, more hardening for some, more mobility for others, all toward the end of having our systems more nearly invulnerable. Our second generation missiles were conceived for these purposes.

I do want to say a few words about our limited war forces. They too are strong and ready. They include virtually our entire armed services excepting only a few single mission, single purpose weapon systems.

It is, of course, impossible for the United States alone to maintain tactical forces large enough to counter simultaneously all possible local communist aggressions throughout the world. Thus we have chosen a course of collective security in company with other nations of the free world who stand with us. Through these arrangements, there has been mobilized across the world a formidable array of tactical military forces. These forces, aided by our military assistance programs and backed up by our own highly mobile land, sea and air task forces, have been and will be, able to deal effectively with local aggressions.

WHO'S WHERE

In the Front Office

Douglass F. Johnson, president, International Aircraft Services, Inc., New York.

Kenneth E. Hunter, vice president of Engineering, Avcon Manufacturing Co., Pasadena, Calif.

John E. Gallagher, a vice president and a director, Slick Airways, Inc. Mr. Gallagher continues as president of Illinois Shade Cloth Co., now a division of Slick.

R. W. Harbison, a vice president, Lear, Inc., Santa Monica, Calif. Mr. Harbison is general manager of Lear's Service Division.

Richard V. Powell, a vice president, Telecomputing Corp., Los Angeles, Calif., and manager of the Electronic Systems Division.

Robert W. Buttvet, vice president, sales, engineering and quality control, The B. C. Corp., Ridgefield, N. J.

Changes

Herbert H. Rosen, formerly assistant director of National Aeronautics and Space Administration's office of technical information and education, now corporate director of public relations for Hoffman Electronics Corp., Los Angeles, Calif.

A. R. Teasdale, Jr., technical consultant, The Martin Co., Baltimore, Md.

Wilbert Schwartzapfel, manager of Missile Systems Engineering, General Electric Co.'s Special Programs Section, Defense Systems Department, Radnor, Pa.

C. E. P. Keen, chief engineer, Welex Electronics Corp., Washington, D. C.

Douglas R. Manre, director of engineering, Tricorrtics, Inc., Los Angeles, Calif.

William H. Heath, director of the newly established Systems Division, CPL Division of General Precision, Inc., Pleasantville.

John A. Felty, plant manager, Colvin Laboratories, Inc., East Orange, N. J.

Carlos C. Wood, engineering manager, Sikorsky Aircraft Division of United Aircraft Corp., Stratford, Conn., succeeding Michael T. Gluhaieff, retiring.

Howard B. Van Dagens, assistant chief engineer, Century Electronics & Instruments, Inc., Tulsa, Okla.

W. W. Beabow, chief project engineer, Skybolt air launched ballistic missile project, Douglas Aircraft Co.'s Missiles and Space Engineering Division, and **J. C. Solvason,** chief project engineer, advanced design, Missiles and Space Engineering Division.

E. C. Titcomb, manager-customer relations, Computer Equipment Corp., Los Angeles, Calif.

Dr. Allen B. Du Mont, group general manager, Allen B. Du Mont Laboratories Divisions of Fairchild Camera and Instrument Corp., Clifton, N. J.

Daniel E. Keller, Jr., Washington, D. C., marketing representative, Amcel Propulsion, Inc.

Dr. Arthur A. Brown, manager, Idaho Test Laboratories, a testing facility to be constructed for Pratt & Whitney Aircraft, a division of United Aircraft Corp.

Karl T. Wilder, senior scientist, Computer Systems Group, Information Technology Division of Lockheed Electronics Co., Plainfield, N. J.

INDUSTRY OBSERVER

► USAF is weighing a Sperry Gyroscope proposal to use modified version of the AN/ASQ-42 B-58 bomb-navigation system in the B-70 instead of the new system being developed by IBM. Sperry claims USAF could save more than $500 million on a 62 aircraft B-70 program this way with little sacrifice in system performance.

► Broad study of background radiation in space is getting under way in one of three phases of Project Vela. Detection and measuring devices will be flown on Discoverer satellites and on National Aeronautics and Space Administration probes. Atmospheric radiation will be studied with sensors on sounding rockets, aircraft and balloons. Knowing background would make detection of unannounced nuclear test explosions easier, will contribute to knowledge of radiobiological hazards of manned space flight.

► British have built a rocket sled test track in Cornwall near where Sir Malcolm Campbell once raced automobiles. Primary purpose is seat ejection tests. Seat for the Hawker Hunter fighter has been ejected at track speed of 700 kt. Velocity apparently is not high enough to permit missile component tests.

► Southwest Research Institute is studying dynamic problems associated with use of hydrofoils for Bureau of Ships. Study will cover such hydroelasticity problems as the possible occurrence of flutter.

► Douglas aircraft is making a field study for Army of bacterial background, using two trailer vans carrying a device to determine particle size and another to identify type through a dye process. Six month study is expected to have civil defense applications and to help develop techniques for bacterial count and identification in space, in planetary atmosphere and on planets.

► General Electric life cell which will carry the first primate into space on USAF's Discoverer program has been successfully ground tested for 72-hr period. Flight is scheduled to last only 27 hr. Respiration and pulse rate will be telemetered, electrocardiogram data will be recorded on tape.

► First test flight of Japan's Kappa-9 three-stage solid sounding rocket to expected altitude of 250 mi. is scheduled for late this year. Four-stage Kappa-10, now under study, is expected to be tested in 1961 and to reach altitudes of 370 to 620 mi. Both are outgrowths of Kappa-6, developed for the International Geophysical Year.

► Lockheed QF-104A target drone is expected to enter Category II evaluation at Eglin AFB, Fla., this fall and become operational on the Gulf test range in the Boeing Bomarc interceptor missile program next June. Two prototype and two preproduction QF-104As now are in Category I testing at Palmdale, Calif. Current program calls for 24 drones.

► Small two-stage sounding rockets are being tested at the Italian proving ground in Sardinia by Societa Italiana Sviluppo Propulsione a Reazione (SISPRE) to study reliability of stage separation and to check and improve telemetry and measuring systems.

► SNAP-8 nuclear space power system will produce 35 kilowatts with one mercury vapor turbine-alternator system and 70 kw. with two systems, higher than the 30 and 60 kw. ratings announced previously. Aerojet is developing SNAP-8 power conversion equipment for National Aeronautics and Space Administration, and the reactor system is being developed by Atomics International Division of North American Aviation.

► Two hydrodynamic towing tanks at Langley Research Center will be reactivated by Navy's Bureau of Ships for research on hydrofoils. The tanks are 2,900 ft. and 1,800 ft. long. Hydrodynamic research has not been done in one tank since mid-1958 and in the other since last December because of decline in NASA's research on seaplanes. Tanks have been used, however, to train Mercury space pilots in egress from capsules.

Washington Roundup

Mercury Investigation

House Space Committee is launching a staff investigation of the Project Mercury man-in-space program. Rep. Overton Brooks, committee chairman, expressed disappointment with the program last week. His staff will try to determine whether Mercury is encountering only normal research and development delays or is in real technical and management trouble.

Brooks predicted the Russians will put a man into orbit in October on the heels of their successful recovery of animals. He said the Soviets will have a man in space by the end of the year at the latest.

Brooks feels Sputnik V compared more favorably with the advanced Apollo concept (see p. 26) than with Mercury. He thinks anything accomplished with Mercury will be anticlimatic after the Soviet success, and he predicts Mercury will be a minimal experiment. Real progress will have to come from Centaur, Saturn and Apollo, Brooks believes.

This kind of congressional thinking could pressure National Aeronautics and Space Administration into a bold, high priority Apollo program. So far, NASA has concentrated all its resources on Mercury. Very little effort has been spent on more advanced concepts, although they get strong support from NASA specialists in the field.

Congressional and public concern for Mercury pilot safety probably will dictate sticking to the present Mercury timetable, although the pilots are anxious to get into the flight phase. Last year, serious consideration was given astronauts' suggestion that one of them fly in a Little Joe shot. Space Task Group decided the limited benefits—up to 200 sec. of weightlessness and 285,000 ft. altitude—weren't worth the risks.

Program is proceeding in three phases—instrumented flights, then a chimpanzee, then a human pilot. Eliminating the chimpanzee would permit manned orbital flight about two months earlier than scheduled.

Nixon Plugs Defense

Vice President Richard Nixon called for a strong defense effort, even at the cost of higher taxes, in a major campaign speech last week. He told the Veterans of Foreign Wars convention that U. S. military strength is second to none in the world and must be kept at this high level. This must be done even if it requires higher taxes—although he sees no need for them now, Nixon said.

Nixon played the Administration theme that defense policy is under constant review and can be changed to meet changing conditions. This leaves the door open for defense increases in situations—political or international—vary during the campaign. Defense Secretary Thomas Gates also took this approach last week (see p. 21).

Defense Department has named John Rubel acting director of defense research and engineering. He will run the office while Director Herbert York is recovering from a heart attack.

Attempt will be made to make the Russians clearly identify the aircraft involved in their world record claims when the Federation Aeronautique Internationale meets in Barcelona in October. National Aeronautics Assn. will propose a change in FAI world record procedures, attempting to revive the pre-World War II custom of furnishing a picture of a record-breaking aircraft to be published by FAI.

This would challenge the Russians who have used obscure designations in submitting record claims. These publicly unknown designations camouflage the identity of military aircraft involved. Soviets have claimed an altitude record with an airplane called the T-431 and a speed mark with an E-66. Apparently these are obscure labels for the Sukhoi delta-winged fighter. All other FAI nations use correct public designations for military aircraft used in record runs.

ANP-B-70 Marriage

Rep. Chet Holifield will become chairman of the Joint Congressional Atomic Energy Committee next year if the Democrats retain control of the House. Chairmanship rotates to a House member next year, and the retirement of Rep. Carl Durham puts Holifield in line.

Holifield believes to the growing view in Congress that the futures of the B-70 and the nuclear aircraft hinge on a consolidation of the two programs. Theory is that this combined program would be a stronger competitor for funds in Defense Department and Congress. Holifield has generally gone along with the efforts of former joint committee chairman Rep. Melvin Price to push the Aircraft Nuclear Propulsion program.

Plans are under way to hold a second World Congress of Flight in Las Vegas in September, 1962. If current planning becomes firm, Air Force Assn. will sponsor the congress, and it will be held in conjunction with the annual AFA convention. National Aeronautics Assn. plans to invite the Federation Aeronautique Internationale to hold its 1962 annual conference in Las Vegas, timed with the World Congress.

—Washington Staff

GENERAL CONCEPT of the Apollo three-man system includes re-entry vehicle-command center based on the Mercury capsule shape, a type of manned return capsule mentioned at the International Astronautical Congress by Wernher von Braun. Propulsion and mission modules could be attached by flexible access tunnels packed under command vehicle during launch as payload for Saturn. Restraining band would be broken and modules erected when system began its mission.

Apollo Conceived as Flexible Spacecraft

Project could produce major man-in-space advances; limiting factors are financing, technical progress.

By Edward H. Kolcum

Washington—Project Apollo, the nation's next major manned space flight program, can be a major advance over current efforts, but its pace and scope will be determined by the amount of money and manpower applied to it and the technical problems encountered.

Robert R. Gilruth, director of the National Aeronautics and Space Administration's Space Task Group, believes Apollo must represent as large a step over the X-15, Mercury and Dyna-Soar as is practical. The questions of support and extent of the program now are being decided within NASA.

When conceptual studies are completed, Apollo could be one step beyond Dyna-Soar as an earth orbiter, or it could have a bolder objective—an advanced vehicle capable of a variety of missions including flight around the moon.

An 18-man team in Space Task Group is emphasizing the advanced approach with studies of a modular-type vehicle able to grow from an earth orbiter to an earth-moon vehicle without fundamental changes. Its growth would be consistent with advances in scientific knowledge and booster capabilities.

The modular approach is representative of a concept, and no firm decision has been made either on a configuration or mission objectives. The Apollo team at Space Task Group is generating background knowledge for the overall project, which presently has no official standing as a national program.

Despite lack of a formal program, NASA is outlining the Apollo concept to industry so companies can be working on it parallel to the Space Task Group effort. Apollo was first described to industry at the NASA-Industry Program Plans Conference last month (AW Aug. 1, p. 34), and Gilruth filled in more details at a Seattle meeting of the American Astronautical Society. The space agency is expected to familiarize interested companies with the system's requirements within a few weeks (see box, column 1, p. 27).

Gilruth describes the modular concept as a three-compartment vehicle. Equipment in one of the compartments could be varied or it could be eliminated, depending on the mission.

Basic spacecraft would consist of a command center re-entry vehicle which would house crewmen during launch and re-entry and would be instrumented for controlling flight. To the command center would be added a propulsion module for flight path changes. It would be jettisoned when its functions were completed.

Command and propulsion modules, Gilruth said, could form a complete vehicle if Apollo were used as a ferry or tug to service permanently orbiting laboratories.

Third compartment would be the mission module containing instruments for specific applications to explore the earth-moon system, or for research in meteorology, geodesy, communications or other space sciences.

Development, construction and operation of such a vehicle," Gilruth said, "presents problems far beyond those expected in the X-15, Mercury and Dyna-Soar."

Among major deficiencies in the technical state of the art and problems in development he lists:

• **Lack of specific knowledge** about solar flare energetic particles and fluxes which are hazardous and could jeopardize consideration of extended space missions. A method to predict periods of high flare activity or a means of light weight shielding is needed.

• **Requirement for precise trajectories** to avoid trapped radiation in the Van Allen belts, and more knowledge about the nature, distribution, orientation and time variation of random cosmic radiation.

• **Space biology advances**, including the need for a sophisticated space garment, an ecological system which could survive launch weight by recycling water, and studies of the influences of weightlessness on tolerances to acceleration, isolation, confinement, illness, work cycles and fatigue, restraint and support.

▪ **Systems developments**, particularly in the fields of three body mechanics, non-plane trajectories, diverse modes of referencing, navigation and control. Also required are new developments in auxiliary power, calling for further study of solar energy, along with communications research in oriented high gain antennas, low noise amplifiers and signal coding.

• **On board propulsion** developments for launch escape, mission abort, mid-course correction, orbit insertion and removal, terminal corridor entry control, orbit modification, retrograde and rendezvous. These developments bring related requirements for storable fuels, restart capability, thrust vectoring, precision cutoff and high reliability.

Automatic Systems

Because the crew will add practicality, flexibility and reliability to the vehicle, fully automatic systems are not planned for Apollo, Gilruth said. Detailed studies will show, he said, "optimum division of referencing, navigation and control tasks between man and machine that will give a total capability far in excess of the sum of the individual capabilities."

Apollo may incorporate a parachute landing system, but unlike Mercury, must include a method for avoiding impact hazards. The vehicle must be able to sustain both land and water impact with long-range location methods, Gilruth said.

Apollo Team

NASA's Apollo team, located with the Space Task Group at Langley Field, Va., is headed by Robert O. Piland under the Flight Systems Division. Its current emphasis is on trajectory studies since each design has an individual optimum flight path based on its lifting ratio.

These studies will evolve into basic research in re-entry, heating, structures, guidance and possibly representative configurations.

Space Task Group hopes quickly to increase the Apollo team to about 50 scientists under a single management group working on basic background information using facilities at NASA research centers. As manpower requirements shift from Mercury to advanced systems, additional scientists from Mercury will move to Apollo.

Both Gilruth and George M. Low, chief of NASA's manned space flight programs, emphasize dependence on industry participation in the total program, beginning with the design studies and carrying through with optimum systems and spacecraft design and fabrication.

At the NASA-industry conference last month, Low gave a program calendar which calls for industry design studies through next June and development contract awards made at that time. Design criteria, he said, would be verified in critical areas of heat protection and shape using Atlas Agena B boosters. Saturn would be used to boost full-scale development and prototype vehicles as well as mission spacecraft.

The Apollo flight program would overlap Mercury, which is scheduled to be completed at the end of 1962. First Agena-Apollo flights would start at the beginning of 1962, with earth orbiters flown in 1966 and circumlunar missions coming with the solution of the technical and aeromedical problems these flights present.

Apollo Meeting Planned For Contractors

Washington—National Aeronautics and Space Administration plans to hold a meeting within the next few weeks to familiarize potential contractors with requirements for Project Apollo.

After the meeting, NASA will ask for design proposals and choose contractors for design studies with contracts for design engineering and fabrication of the complete Apollo system planned for mid-1961.

NASA has said that the major developments needed for Apollo are the basic re-entry vehicle, environmental control system, attitude control system, power supplies, communications system, on-board propulsion, guidance and control system and pilot displays.

German Army Wants Nuclear Warheads

Paris—German military officials have touched off a hot political issue within NATO ranks by publicly demanding the right to equip German troops with nuclear weapons.

German demand, contained in a brochure entitled Conditions for an Efficient Defense, quickly drew sharp criticism from West German Social-Democrat leaders as well as from officials in other Western European capitals. Request, which goes directly against West German armament control provisions agreed to by Bonn in 1955, marks the first time Bundeswehr officers have moved publicly in West German politics.

Timing of the West German military demand indicates an attempt to influence NATO debate this fall on use of the Polaris IRBM weapon within the NATO area. German officers reportedly are banking on U.S. backing for their demand, although other NATO members have mixed feelings on the subject. It was believed in NATO circles here that Bundeswehr officers have the backing of West German Defense Minister Franz Josef Strauss.

In their request for nuclear weapons, Bundeswehr officers didn't spell out how the issue of control should be handled. At the moment, German troops are equipped with dual capacity weapons, such as the Matador tactical missile and the Nike Ajax anti-aircraft missile. Only conventional warheads for these missiles are delivered by the U.S. to German troops. Although the Bundeswehr brochure does not say so, NATO sources indicate the Germans are thinking in terms of a joint control system placed under NATO command.

The Bundeswehr brochure argues at one point that nuclear warheads are necessary if German anti-aircraft efforts are to be effective. This demand for nuclear capability in anti-aircraft weapons is timely since West Germany is participating heavily in the NATO Hawk anti-aircraft missile production program, putting up nearly half the cost for the $440 million program.

German Defense Ministry later defended the thesis presented by German officers, but emphasized that this demand does not reflect desire of the Bundeswehr to obtain independent nuclear firepower. It only seeks to obtain nuclear capability within the NATO command structure, the Ministry said.

Defense Ministry confirmed at the same time that Gen. Lauris Norstad, SHAPE commander, has approved West German naval demands for anti-aircraft destroyers in a 6,000 ton class previously limited under terms of the 1955 armament treaty to 3,000 tons. Larger size destroyers are now needed, the Defense Ministry said, to handle anti-aircraft missiles such as the Raytheon Hawk and Convair Tartar missiles.

Russians Plan More Unmanned Sputniks

Moscow—Another series of experimental space launchings will precede man's flight into space despite the successful return of the first living creatures from orbital flight, Prof Alexander V Topchiev, vice president of the USSR Academy of Sciences, said last week

Although Topchiev said man will fly "in the near future," he said manned flight is so complex that more experiments aimed at solving a great number of problems will be made, despite Russia's successful recovery of two dogs and a wide range of lower forms of life after a one-day flight in the 10,120-lb Sputnik V Other scientists meeting with newsmen seemed anxious to dispel any belief that Russia would try manned flight within the next few weeks

The two part spaceship was launched Aug 20 into a near-circular orbit with an apogee of 210 mi and a perigee of 190 mi, a period of 90 72 min and an orbital inclination to the equator of 64 57 deg

Both parts re-entered on the 18th pass in response to a ground command, Russia said The capsule containing the living organisms landed only about 6 25 mi from the intended point Official statements did not say where the landing was made

The launching coincided with the 11th annual congress in Stockholm of the International Astronautical Federation, which is headed by leading Soviet space scientist Leonid I Sedov Sedov and three other members of the seven-man Russian delegation held a press conference shortly after the launching Asked if they timed their shots to coincide with IAF congresses Sedov first said Russia followed its own program without regard to such meetings Then he smiled and said "Think of my side Maybe I time the congresses to coincide with our launchings"

The recovery followed by one day and overshadowed the first midair recovery of a re-entering capsule (see p 30) This Discoverer was the second capsule to be successfully re-entered and recovered by the U S

Soviet delegates at Stockholm had refused to say whether the capsule would fall on land or at sea, but said both are entirely possible They also threw no light on when the first Russian will be sent into space The August launching tended to favor the theory that Soviet shots are timed for psychological impact, rather than based on meteorological considerations, as Russia's choice of spring or fall for most previous shots had led some to believe

Speculation among U S delegates at Stockholm, in spite of Sputnik V's success, was that Russia knows the U S timetable for manned space flight and will surely attempt to beat that but will meanwhile take as much time for research as it possibly can afford

Comments by Soviet scientists here have emphasized the successful solution of the re-entry and soft-landing problems and have agreed that the flight hastens the time when manned space stations can be put in orbit They did not overlook political implications, continuing the theme (AW Aug 22, p 33) that the U S is concentrating on spy and other military satellites while Russia pursues peaceful aims in space

According to the Soviet press, Sputnik V carried the following in its capsule two dogs, Belka (Squirrel) and Strelka (Little Arrow), six white and six black mice, insects flies or drosophila in 15 flasks, the plant chlorella in eight ampules in a liquid nutritive medium in the form of suspensions and four ampules that the news agency Tass called slanted agar fungi—actinomycetes in 14 ampules, seeds of different varieties of maize and wheat peas onions and rugella

Contents of Capsule

The capsule also contained small sections of human and rabbit skin in two ampules and what Tass calls human cancer cells in six ampules A full range of bacteria carried included intestinal bacilli K-12 in eleven ampules intestinal bacilli B in six ampules intestinal bacilli of the "aerogenes" type in four ampules butyric fermentation bacillus in two ampules staphylococci in two ampules desoxynucleic acid in six ampules bacteriophage T-2 in three ampules and bacteriophage 13-21 in three ampules

In addition to the animals in the capsule the cabin of the satellite carried 13 white laboratory mice, 15 black mice and two white rats Russia said

Scientific equipment carried was for measuring light and heavy nuclei of primary cosmic radiation X-ray and ultraviolet radiation from the sun and level of doses of cosmic radiation in the container with the animals

Blocks of thick nuclear photo emulsions totaling about 130 lb were carried, and one block was fitted with a device for development of emulsions directly on the ship Data from this was stored and relayed on command after each pass and just before landing of the satellite Soviets said

Cabin temperature remained at 20C and air pressure, composition and humidity stayed within established limits A special chemical compound absorbed carbon dioxide and water vapor and produced oxygen

Dogs were fed at intervals by automatic devices They had been specially trained during the past year and were chosen because they were calm and even-tempered Belka weighs 10 8 lb and Strelka 12 1 lb Strelka is two years old, Belka slightly over two

During training, they were required to wear special monitoring devices Their carotid arteries were led out into a leather bag on the neck to ensure the most accurate measurement of blood pressure Electrodes were introduced into their bodies for taking electrocardiograms, Russia said

Long training accustomed them to confined spaces, restricted movement, carrying of the monitoring devices and receipt of food from automatic devices

During spaceflight the dogs were given jelled food containing nutritive substances from sesame seeds and water They were fed twice daily

Dogs were especially dressed They wore rubber bibs and shorts connected to facilities for holding excreta Over this they wore so-called flying clothing made of Kapron which protected centers placed in the animals bodies against damage from the outside

None of these preliminary operations affected their physiological state according to the Soviets In the spaceship cabin they were placed next to each other separated only by a thin net

Television observation was conducted from the start virtually to the beginning of landing—in other words all the time the vehicle was in range of the receiving stations Pictures received were recorded on film timed with precision to information being transmitted by the telemetering system

Pravda said at the start of the flight the dogs looked "with alarm and bewilderment to the bottom of the cabin During the first few seconds of flight they worried and began to toss As the vehicle gathered speed the growing force of gravity pressed them to the bottom Strelka setting her paws against the floor tried to put up resistance, anxiously looking around The animals then stood still The vehicle went into orbit After the great forces of acceleration the state of weightlessness set in The dogs hung in the cabin Their paws and heads were weakened, hanging down, and the animals looked lifeless at first glance Getting used to weightlessness, they began to eat as the feeding-trough opened automatically As the flight continued they again began to worry but gradually calmed down"

Soviets say instruments registering basic physiological functions of the animals worked with "sufficient" accuracy A large number of electrocardiograms were taken Heart tones, blood pressure, frequency and character of respiration and movements of the animals were recorded and radioed to earth

Before launching, Strelka's pulse was 90 and respiration frequency 60 During orbit, Strelka's pulse went up to 160 and respiration to 125 After 90 min of flying, pulse was 65 and respiration 24

Belka's pulse before launching was 75 and respiration 24 During orbit pulse went to 150 and respiration to 240 After 90 min of flying pulse dropped to 72 and respiration to 12

Soviets say this means physiological functions went back to normal during the weightless state

Flight of Sputnik V was observed by 92 visual and photographic monitoring stations in the USSR and by more than 300 foreign stations cooperating, according to the Soviets

Period per revolution around the earth diminished by 0 003 min per 24 hr due to drag

Ari Sternfeld, Russian astronomer said the height of 198 mi was chosen for orbit because no matter from where the future space travelers will be returning—whether from artificial satellites or the moon or other space journeys—the last lap of the flight will be through the earth's atmosphere Here the spaceship can be decelerated by braking action of the atmosphere and this process will start at an altitude of lower than 190 mi, so there was no point in the satellite spaceship going higher, he said

Sternfeld said the comparatively low orbit meant the animals would experience high effects during entry into the denser layers of the atmosphere and this would check the effectiveness of their protection from aerodynamic heating at speeds close to first escape velocity

Soviets also were proud of the near circular orbit Prof S Poloskov said the solar system does have planets and natural satellites moving over orbits approximating the circular, but no celestial bodies known to man move over orbits as near to a circle as the spaceship's

During descent changes in the physiological functions of experimental animals were continually recorded by systems aboard the spaceship Blocks with nuclear photoemulsions and other scientific equipment were recovered

Special equipment transmitted data to earth characterizing functioning of the braking apparatus and system control over descent, an Academy of Science spokesman said Parameters were recorded while the spaceship re-entered dense layers of the atmosphere

The spaceship landed in a meadow First on the scene were collective farmers working in the vicinity An observation plane landed shortly after carrying specialists who were the first to open the doors of the ship A helicopter carrying a doctor to check the health of the animals landed an hour later He found them feeling well Soviets reported the crowd watched Belka and Strelka jump from the opening barking and nuzzle people with whom they had worked Within a few hours they were described as eating with appetite preferring a nut paste preparation The dogs and other animals and plants were flown to Moscow during the night of Aug 20 21 There they were bathed, after which electrocardiograms and recording of heart tones were made and blood pressure was measured

All showed that the dogs' condition was normal

Other experimental animals also were found in good conditions Mice willingly nibbled on "sport" biscuits and other food The flies flew around in the flasks in which they made the trip One of the plants aboard the spaceship continues to blossom Radiation effects will be established if gray hairs appear on dark skin of the mouse So far there are no such changes in pigmentation, say the Soviets

Hereditary changes also will be studied on the flies and their eventual offspring

Delicate changes in cells of plants which might occur as a result of the stay in outer space will be studied Laboratory tests are being made on fungi and some microscopic organisms which made the trip The Academy of Science says results of all these laboratory investigations will be made to the public

"The hour is nearing when man will emerge from ferrestrial atmosphere for the first time," said Yevgeni Fedorov, secretary of the Academy of Sciences He said the main purpose of this experiment was to enable further check on instrumentation guaranteeing safety and normal conditions for man

Candidates Select Advisory Teams

Washington—Presidential campaign speeches this fall will likely reflect an academic approach to defense, space, transportation and other issues as both candidates lean heavily upon leading educators for advice and ideas in these areas

Vice President Richard Nixon, Republican presidential candidate has formed an 18-man "Policy Advisory Group" 12 of them educators They are all noted experts in their various fields and will be called upon on an informal basis to help him expand his "thinking in depth on key questions" Nixon's views will be issued in a series of written papers and used in the preparation of speeches

Kennedy Team

The largest group of advisers has been organized by Sen. John Kennedy the Democratic presidential nominee It draws heavily on the faculty and staff of Harvard University and the Massachusetts Institute of Technology The opinions and ideas drawn out of this group will help formulate Sen Kennedy's approach to defense and other national problems

The winner of the presidential race probably will continue to rely upon his own group for advice and ideas in carrying out his program after he takes office in January

Vice President Nixon's advisers include Dr Paul W Cherington of the Harvard school of business administration, author of the Cherington Report on the status and economic significance of the airline equipment investment program The group also includes Dr John A Hannah, Michigan State University president and a former assistant secretary of defense for manpower and personnel, Dr John T Heller, director of the New England Institution of Medical Research, Dr Joseph Kaplan, physics professor at University of California at Los Angeles and former chairman of the U S committee for the International Geophysical Year; David Sarnoff, board chairman of Radio Corporation of America; Robert C Sprague, president of Sprague Electric Co, and Dr Philip W Thayer, dean of the school of advanced studies, Johns Hopkins University

In addition to this group, the Vice President's advisers also include Dr. Edward Teller, noted nuclear scientist and University of California physicist; Dr Herbert F York, director of defense research and engineering Dr George B Kistiakowsky the President's scientific adviser, and other cabinet officers and governmental department heads

Expanding Advisory

Sen Kennedy's group already numbers more than 30 and is expanding rapidly They include Jerome B Wiesner, director of MIT's Research Laboratory of Electronics, who is also a member of the President's Science Advisory Committee and a former staff director of the Gaither Committee Bruno B Rossi an MIT physicist and a member of the National Academy of Sciences space science board, and Lt Gen James M. Gavin, retired former head of Army research and development and currently president of Arthur D. Little, Inc., an industrial research company

C-119's Third Pass Snares Discoverer

By John Nammack

First air recovery of an object from space—an 84-lb instrumented capsule from Discoverer XIV which had been launched into orbit the previous day from Vandenberg AFB, Calif.—was made by the crew of an Air Force C-119 Flying Boxcar Aug. 18 at an altitude of 8,500 ft., 200 mi. from the center of the capsule's predicted impact area.

The General Electric re-entry vehicle was ejected from Discoverer XIV over Alaska while on its seventeenth pass around the earth. A timing device caused gas jets to pitch the vehicle 60 deg. down from its horizontal plane, after which a series of explosive bolts and springs accomplished separation.

A retrorocket within the capsule was then fired to slow the vehicle to re-entry velocity, enabling it to assume proper trajectory for re-entry into the earth's atmosphere. Before reaching 60,000 ft., deceleration forces had activated a switch to release a parachute which then lowered the capsule at a rate of descent between 1,400-1,600 fpm.

Recovery Aircraft

The capsule was retrieved by Fairchild C-119 No. 518037, one of nine Flying Boxcars of the 6593rd Test Squadron (Special) equipped to perform this mission. The squadron also has a Lockheed C-130. Supporting units included radar-equipped Lockheed RC-121 aircraft for airborne control of the recovery aircraft, two Douglas JC-54s and two Liberty ships from the Military Sea Transport Service to provide telemetry pickup on the capsule, a Lockheed U-2 to measure infrared radiation from the capsule, and four ground stations to track the descent of the vehicle and provide initial vectoring data to the recovery aircraft.

The recovery area described a 200 x 60-mi. rectangle. Six C-119s and the C-130 flew within this "ballpark" area, while three other C-119s, including the actual recovery aircraft, patrolled an "outfield" area embracing an additional 400 mi. The aircraft, operating at varying altitudes up to 16,000 ft., flew a maximum rescue search pattern, perpendicular to the trajectory of the re-entry vehicle. Flying this creeping search pattern, aircraft make 90 deg. turns at approximately 10-min. intervals while maintaining a predetermined separation from each other.

Capt. Harold E. Mitchell, aircraft commander of the C-119 which caught the re-entry vehicle, was flown into New York with two members of his nine-man crew last week where he described the recovery. Capt. Mitchell gave the following chronology of his successful mission, (all times are Zulu, i.e., Greenwich times):

- **2253**—First stable signal received from capsule's telemetry beacon. Mitchell began his first 360 deg. orientation turn.
- **2256**—Second 360 deg. turn for positive identification.
- **2306**—First visual sighting of capsule and parachute.
- **2309**—Recovery gear hooks capsule's parachute on third pass.
- **2323**—Capsule brought aboard the aircraft.

Capt. Mitchell sighted the capsule dead ahead of his aircraft at an approximate altitude of 16,000 ft. With a sink rate averaging 1,500 fpm. for the capsule, Mitchell had about 10 min. to effect recovery—the period during which the capsule would pass through the aircraft's maximum and minimum operational altitudes.

After missing the parachute by 6 m. on his first pass, Mitchell turned for another pass at about 10,000 ft., missing this time by 2-3 ft.

Two decks of scattered clouds lay below at 7,000 ft. and at 2,000 ft. Mitchell banked steeply at 8,500 ft. with power back at a standard C-119 let down airspeed of 110 kt., and on the third pass engaged the capsule's reinforced parachute with the aircraft's recovery gear. The capsule was hauled aboard the aircraft by T/Sgt. Louis Bannick, the winch operator, at 2323, 30 min. from the time Lt. Robert Counts, the navigator, had first reported a steady signal from the capsule's radio beacon. The 7,000 ft. cloud deck might have prevented a third pass.

Capsule altitude was roughly 55,000 ft. at the time the signal stabilized. A wavering signal had been picked up about 15 sec. earlier, and had also been reported passing overhead by another aircraft.

The signal is emitted by a telemetry beacon within the capsule and is monitored primarily by oscilloscope aboard the aircraft, but is also detectable aurally. The aircraft's telemetry receiver, designated FLR-2, is manufactured by Radio Corporation of America and is procured by the Air Force on an off-the-shelf basis.

Mitchell said that his crew succeeded in locating the capsule by simply homing on the telemetry beacon without assistance from other aircraft engaged in the search. He pointed out that at the time of the recovery, the nearest aircraft was 130 mi. away from his position.

A four-way course ambiguity is possible in detecting the signal from the beacon. In addition to the normal on-course and reciprocal ambiguities, the receiver also picks up two 90 deg. readings because of peculiarities of the antenna.

Signal Distinction

Two Yagi-type antennas are installed on the nose of the aircraft, providing a dual presentation on the oscilloscope. The 90 deg. off-course ambiguity can be detected by differences in the height of the sweep on the two presentations. There is a lobing relay that carries the sweep from one side of the scope to the other, one side representing one antenna, and the other the second antenna. Amplitude presentations for the reciprocal and on-course readings can be similar. However, in making small homing corrections on the reciprocal, the apparent correction will distort the height pattern between the two scopes further, rather than lining them up.

When Lt. Counts received the first stable signal from the capsule beacon, Mitchell made a 360 deg. standard rate turn to solve the ambiguity. At the end of this turn the aircraft was on the reciprocal heading, therefore making it necessary to turn back another 180 deg. Three minutes later Mitchell then made another 360 deg. turn to double check that his course was correct.

The importance of resolving the ambiguity problem accurately can be seen by the fact that should the crew mistake the reciprocal for the homing course, the aircraft can be 50-60 mi. away from the capsule at recovery time.

The C-119 aircraft assigned to the recovery mission were "J" models powered by two Curtiss-Wright R3350 compound engines. Most of the aircraft had seen service in the Korean War, including Capt. Mitchell's aircraft, whose designation appears in this Aviation Week pilot's logbook for that period. The aircraft had been modified with dual nose gear, beaver tail rear cargo doors in place of the original clamshells, Aeroproducts propellers replaced the Hamilton Standard blades, a 1,000 gal. Benson tank was added internally, and the recovery unit manufactured by All American Engineering Co. was installed.

Personnel of the 6593rd Test Squadron, most of whom have served together in the Air Force for the past 10 years from Korea-Miami-Charleston AFB to points north and west, were trained for their mission at Edwards AFB, Calif., by Air Force Ballistic Missile Division and Lockheed personnel. They left Edwards in December 1958, for assignment to Hickam AFB, Hawaii. During the past year and a half, they have engaged in practice air recoveries of dummy capsules dropped from 45,000 ft. by B-47s. Experience level of these crews is high. The aircraft commanders of the nine C-119s assigned to the recovery mission average over 4,500 flying hours, most of which have been logged in Flying Boxcars.

In connection with plans for subsequent capsule recovery attempts, Maj. H. C. Howard of USAF's Development Directorate told a press conference at the International Astronautical Congress in Stockholm that USAF hopes "at some reasonable date to do over land recovery" of Discoverer capsules.

If this type of recovery were perfected, it would mean that the sizable air and sea fleets now employed in recovery could be largely eliminated. Current capsules have zero lift, and control surfaces or "some other forces" would have to be added before land recovery could be accomplished, Howard said.

There is a strong likelihood that the capsule will increase in size and change in configuration as the program progresses, since its purpose is to explore research and development techniques for manned space flight and since both the more powerful Agena B upper stage and the more powerful Atlas booster are planned for eventual use in the program. The Air Force will then probably replace the C-119 aircraft with C-130s to handle the larger vehicles.

Discoverer XIV payload consisted of the same instrumentation, telemetry and re-entry capsule as that of Discoverer XIII, retrieved Aug. 11 from the Pacific Ocean (AW Aug. 22, p. 33). In addition, Discoverer XIV carried a special 10-lb. tracking experiment for Navy's Project Transit vehicle.

Bendix to Design Advent

Washington—Bendix Corp. has won a hotly contested competition to develop Project Advent military active-repeater communications satellite system, intended for synchronous 22,300 mi. high orbit. Program, which replaces several earlier Army and Air Force communication satellite development projects, is sponsored by Advanced Research Projects Agency under technical direction of Army Signal Corps. Bendix Systems Division, which earlier held USAF contract for Project Steer, a 5,600 mi. polar orbit communications satellite, has received a $2 million Army letter contract. Bendix Radio Division also will work on the program.

Echo Enters Shadow

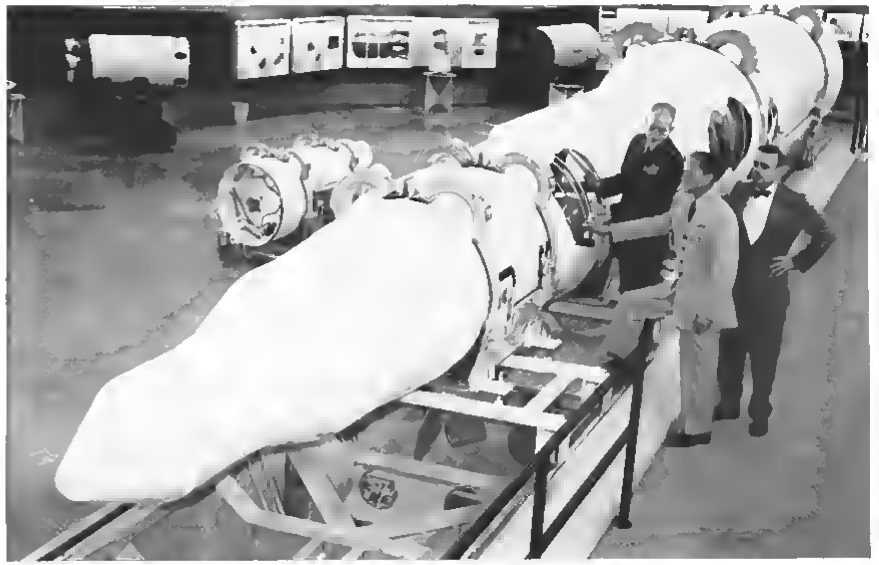
Washington—Echo I satellite entered earth's shadow last week for brief periods in each orbit, giving scientists the opportunity to observe endurance of the 100-ft. inflated sphere under wide temperature changes.

Echo was launched Aug. 12 (AW Aug. 22, p. 30) and withstood intense Perseid micrometeorite shower and pressure generated by several solar flares without appreciable change of orbital elements or noticeable distortion in shape.

Periods in earth's shadow will be at minus 50F. In sunlight, sphere is at a temperature of about 240F. Sublimating materials used to expand the satellite may return from gaseous to solid state in darkness, which could result in Echo losing its spherical shape.

Echo went into the earth's shadow two minutes in its first period of darkness, and this time gradually will increase to about 30 min. by mid-December. Time of darkness then will decrease.

By last week, more than 200 experiments and transmissions had been conducted with Echo as a relay, including transatlantic signal and voice bounces.



Air Force Inspects Operational Minuteman Configuration

First photo of the operational Minuteman configuration, including the Avco Mark 5 re-entry vehicle, shows the display at USAF's Developmental Engineering Inspection at Boeing Airplane Co.'s Seattle plant. Display included either actual hardware or mockups of re-entry vehicle, individual solid propellant stages, operational silo, launch control center and transporter erector. Col. Samuel C. Phillips, Minuteman program director for Ballistic Missile Division, said no major change would be required before first test launch at Cape Canaveral, Fla.

GV-1 Tests Operational Refueling Hookup

First production Lockheed GV-1 is flown by Lockheed Marietta pilots in making the first operational style refueling hookup of the Marine Corps version of the C-130B. Marine pilots flew two Douglas A4Ds from Cherry Point MCAS for the operation. Lockheed will deliver this airplane, first of 16 ordered out of Fiscal 1960 and 1961 funds, to the Naval Air Test Center at Patuxent River, Md., for start of Bureau of Inspection and Survey (BIS) testing in September. GV-1 carries 10,560 gal. of jet fuel, and can refuel two aircraft at a time in 3-4 min. through paradrogues trailing from pods at the wingtips.

Northrop Wins USAF Contract For Low Drag BLC Program

Hawthorne, Calif.—Northrop Corp.'s low drag boundary layer control system will be flight tested on two bailed Douglas WB-66D aircraft. Scheduled cost of the program over the next three years is $27 million and the first aircraft is to be ready for flight testing in about two years.

Emphasis on the Northrop project is on the low drag aspect of boundary layer control rather than high lift. Numerous high lift boundary layer programs have been conducted in the past but this will be the first such full scale BLC application for reducing drag during cruise flight.

Use of of laminar flow control will effectively decrease skin friction at cruise speeds so that the range of large aircraft can be nearly doubled, Northrop says. An aircraft that normally has a range of 4,000 mi. can cruise a distance of 7,000 mi. using low drag boundary layer control while carrying the same payload and fuel load.

Wing and Tail Slits

Northrop's approach to low drag BLC is to draw off the turbulent boundary layer through a series of spanwise slits in the wing and empennage. A plenum chamber built into the wing passes the air into ducts where it is routed to the rear of the aircraft and exhausted for its residual thrust value. The BLC slits vary in size and frequency of placement, being wider and farther apart toward the leading edge, narrower and closer together downstream. Widest of the slits will, however, be less than ¼ in.

Complete rebuilding will be necessary for the B-66s, primarily to adapt the wing skin and integral fuel tanks to accommodate the slits, plenum chambers and ducts. The WB-66 has a faired tail carrying electronic gear instead of the tail turret of the other B-66 versions.

Contract was awarded to Northrop by USAF's Air Research and Development Command.

Pumping action will be achieved through the use of a small turbine engine mounted in the fuselage. The engine most likely will drive a vacuum pump of sufficient size to permit wide variations in pumping capacity for test purposes.

Theory of low drag BLC has long been known but a practical method of adapting the principle to aircraft surfaces has not been known. During 1955 and 1956, Northrop applied electronic data processing to the solution of boundary layer equations and made possible the analytical design of suction surfaces. Methods were developed to determine suction requirements and distribution, suction power and effective drag. At this same time, Northrop demonstrated the feasibility of applying low drag boundary layer control to a 30 deg. swept wing in a wind tunnel.

Conceptual development of laminar flow control also has considered other facets of the program, including surface waviness and roughness criteria, reduction of system performance because of weather and methods of maintaining clean, unobstructed suction slots for optimum airflow.

Solutions Achieved

Solutions to the manufacturing problems associated with applying low drag BLC to aircraft have been found by Northrop's Norair Division and include:

- **Methods** by which suction holes, plenum chambers, and final slitting can be done to very close tolerance in a minimum of time.
- **Development** of a slitting head to be used in automatically drilling suction holes and milling plenum chambers. Experience already has been gained in slitting to the required tolerance.

Northrop already has over 300 flight hours of experience with low drag BLC gained during a program in which a Lockheed F-94 was fitted with a slotted suction glove on one wing. Northrop reports that 100% laminar flow was achieved on the wing glove at Reynolds numbers as high as 36 million.

The flight test program also afforded experience in developing instrumentation to recognize and measure laminar flow. Among the more significant developments are:

- **Total and static pressure measurement** techniques on boundary layer control to accuracies of less than .20 in. of water.
- **In-flight liquid manometers** with high accuracy and versatility for cockpit monitoring.
- **Pressure probes** capable of measuring boundary layer thicknesses of less than .1 in. with seven point backup accuracy.
- **Automatic pressure** sampling systems capable of handling 48 pressures per unit with 1.5% full scale accuracy.
- **Suction control methods** on individual suction chambers with a high degree of controllability and accuracy.

Northrop estimates that a 50% reduction in skin friction drag is possible with the application of low drag BLC to the wing and empennage of a large aircraft and up to 100% reduction if it is applied to the fuselage of the aircraft as well.

The principle is envisioned as applying to a variety of roles filled by aircraft in addition to the increase in range offered for transport aircraft. Greater on-station time is possible for airborne early warning aircraft, anti-submarine patrol, airborne missile launchers etc. Prospects for a nuclear powered aircraft are enhanced, Northrop says, because of the reduction in power necessary for cruise permitting smaller engines which in turn cuts down on the shielding requirement.

One specific application for a successful system might be on the Boeing KC-135 Stratotanker, reducing Strategic Air Command dependence on foreign bases. Boundary layer research at Northrop has been headed since 1955 by Dr. Werner Pfenninger, who began his first work on the subject in 1937 while at the Zurich Institute of Aerodynamics in Switzerland.

Pershing Range Stretch

Changes in Army-Martin Pershing missile necessary to extend its range from present maximum of 300 mi. out to 750-1,000 mi., which would make it a contender along with Polaris and a small Minuteman for adoption by North Atlantic Treaty Organization countries, were outlined to Army Ballistic Missile Agency officials by Martin. Martin's detailed analysis including proposals from major subcontractors, is a company initiated effort but presumably would not have been made without evidence of Army interest and approval. Lt. Gen. Arthur G. Trudeau, chief of Army research and development, recently said that Pershing range could be increased to 1,000 mi. "in a relatively short time" and that a 300-mi. range missile would be with troops in the 1963 period.

Negotiated Defense Contracting Supported by Senate Committee

By Katherine Johnsen

Washington—Senate Armed Services Committee made the first major congressional defense of negotiated contracting in complex military procurement in a report last week to the Senate.

The committee took the position that the prime objective is maximum competition—whether by formal advertising or negotiation. Its report observed that "formal advertising . . . is not an end in itself and that 'negotiation does not necessarily mean the absence of competition.'"

The report was issued pursuant to the renegotiation extension law, which directed both House and Senate Armed Services Committees to make studies of defense procurement policies. Under the law, these are to be followed by a study of the renegotiation process by the Joint Congressional Committee on Internal Revenue—composed of the top-ranking members of the House Ways and Means Committee and the Senate Finance Committee—due Mar. 31, 1961.

The three reports will be the basis for congressional consideration of a further extension of the renegotiation law, which expires June 30, 1962.

The House Armed Services report was generally critical of negotiated contracts, particularly cost-plus-fixed-fee and fixed-price incentive types widely used in missile and aeronautical procurement (AW July 4, p. 38). It led to House passage of legislation requiring contractors on incentive-type contracts to certify that their cost data in negotiate. House Armed Services also recommended that renegotiation be made permanent law.

The Senate committee, on the other hand, declared that all of the major contract types now in use have appropriate uses if applied in the circumstances in which their use is intended and if skillfully negotiated and administered. All of the major contract types now used can produce undesirable cost, price, or profit consequences if used inappropriately or if they are not carefully negotiated and administered.

"Indispensable prerequisites for formal advertising frequently do not exist in modern military procurement and hence some contracts must be negotiated."

The committee made no recommendation on renegotiation, stating that this was within the jurisdiction of the Senate Finance Committee. It made several recommendations to Defense Department to improve procurement contracting administratively, and said that it would take no legislative action until receiving a report from the department next January on steps taken to implement those recommendations.

The recommendations include:

- **That each incentive-type** contract contain a provision permitting adjustment to exclude profits based on inaccurate, incomplete or out-of-date information furnished by the contractor. The committee recognized that, since several reports by General Accounting Office highlighted inaccurate cost data, Defense Department has required contractors to furnish certificates of cost, but said that the safeguard of a contract provision is also desirable.
- **That procurement regulations** should "affirmatively" express a preference for formal advertising "in all cases in which this method is practicable," even though authority for negotiated contracting might exist.
- **That the military departments** and contractors "evolve a system that will permit broader notice of proposed subcontracts without imposing an unacceptable delay or burden of paperwork."
- **That government procurement** officials generally be required in negotiated contracting to conduct discussions with all responsible companies submitting proposals within a competitive range. The committee would not make the requirement inflexible, because this could encourage bidders to pad their initial proposals and not quote their best prices first.
- **That authority for negotiation**—spelled out in procurement law in 17 possible "exceptions" to formal advertising—require more explicit justification. The committee said that the justifications now "tend to be brief and stereotyped and . . . do not provide enough information to show the factors upon which the decisions were based."

The three main justifications used for missile and aeronautical negotiation of contracts are "impractical to secure competition by formal advertising," "experimental, developmental or research" and "technical or specialized supplies requiring substantial initial investment or extended period or preparation for manufacture."

The committee's report showed that of $16.2 billion in Fiscal 1959 procurement, over half, or $8.2 billion, was by negotiation with one source. A $3.4 billion figure was by advertised bid, $2.4 billion by competitive negotiation, and the remainder was for purchases under $2,500 or for purchases overseas.

Soviets Meet Stiff Opposition In Attempts to Change IAF Rules

By Evert Clark

Stockholm—Soviet Prof Leonid I Sedov has been re-elected president of the 29 nation International Astronautical Federation after heatedly rejecting a change that he tried to introduce "colonialist" policies into conduct of the federation's business

Russia's seven-man delegation to the IAF's 11th annual congress here suffered one defeat but won one apparent victory as the U S joined with smaller nations to insist that officerships in the federation be based on achievement rather than nationality (AW Aug 22 p 26)

Russia had used attempts to revise the federation's 10 year-old constitution as a device for introducing

• **Demand that both the U S and the USSR be guaranteed either the presidency or a vice presidency each year**

• **Veto power for both the U S and the USSR in the IAF Bureau, a permanent secretariat which the new constitution will create to carry on IAF business between annual congresses With this veto either country could prevent any issue from coming before the next congress for discussion**

U S delegates, representing the American Rocket Society, American Astronautical Society and Aerospace Medical Assn opposed both proposals at a caucus held here immediately before the congress and deplored the introduction of what they called political issues into an organization founded for the international exchange of scientific and technical information

Argentina Objects

When the revised constitution came up for discussion at the final business session of the congress, Argentina's Prof T M Tabanera proposed appointing a special committee to study the revisions and report back next year He said the paragraph on guaranteed representation for Russia and the U S "may be some new kind of colonialism," and said that while Russia and the U S had achieved much in space flight "I don't see that this is a reason to put this new paragraph in the constitution" Delegates from Britain and the Netherlands agreed with his position

Then Sedov, who as president was conducting the meeting, spoke

"I am slightly astonished," he said, "that in order to discuss things in the constitution it seems one needs a whole year You must agree the rate does not correspond with the rate that astronauts themselves have maintained"

Sedov said the Soviet space group has "sufficient" tasks to keep it busy but nevertheless we have found it possible to give our attention to the proposed new statutes He agreed the proposals might not be perfect but said "life is going on very rapidly" and it might be better not to wait for perfection

"We have heard certain doubts" he said "but we have to consider what realities these two countries [U S and USSR] deserve certain consideration" Sedov said other countries will eventually merit guaranteed representation because of their space activities, and the situation could then be changed to take account of this

Sedov Motion

Sedov moved that the revised constitution be adopted in principle as the federation's temporary statutes and that a work committee be named to recommend changes shortly after the congress

Switzerland West Germany and the U S then restated the Argentine position that representation must not be imposed by the constitution but should be left to free election

Sedov obviously agreed said he saw that the consensus was that the question could not be settled immediately He said he noted that IAF officials who had not objected to the revised constitution when a draft was circulated at a meeting of the top officers in Heidelberg, Germany last May were objecting now

"I think the observation about a spirit of colonialism we can take only as a jest—as a jest which we can simply put aside" Sedov said Russia's basic intention had been to assure that "leading personalities," especially vice presidents, had a voice in making basic decisions, he said

There could be "differences of opinion" on basic representation for the two major countries, he said, "but I see these circumstances met with a certain amount of bad will—considerable bad will but I would like to remind you first of all that this practice exists in international relations now and with international organizations, not only in political ones but also scientific ones"

It is necessary to make use of the practical experience and the competence" of those who have achieved space flight in settling practical questions, Sedov said

"I am slightly astonished with the fact that serious objections are raised to legal steps which reflect the actual situation, the more so because they can be changed in the future," he said

The draft statutes reflected "not a shade of what has been called here, not seriously I believe, 'colonialism,'" Sedov said Then he proposed putting off adoption of the constitution until the next congress, and having a committee study it in the meantime—and he promptly named the committee, as if he had prepared the names ahead of time It included U S lawyer Andrew G Haley, former IAF president who has been working on constitution revision Sedov himself a Czechoslovakian lawyer as chairman W H Pickering of the Jet Propulsion Laboratory, Prof E A Brun of France and Dr Leslie R Shepherd of Great Britain

Sedov also said the IAF should in the interim have the proposed limitation—in which the veto power would reside for the U S and Russia—"which could art and in whose name the President could take action on appropriate matters"

Moving swiftly, Sedov insisted on and got a vote—21 for, none against and one abstention—before U S representatives realized that under Sedov's interpretation the interim might include the still-undiscussed veto power

U. S. Position

When American Rocket Society President Hammond Seifert made the point that the U S agreed to the interim use of the interim in principle but did not agree with the part of the constitution defining its powers Sedov said that the matter would be taken into account

But Sedov said the bureau will act as an interim organization in accordance with the draft constitution, and added "We have now finished this question" Whether Russia attempts to make use of the veto power between now and the next congress remains to be seen

The IAF council elected Sedov president for his second term and re-elected Shepherd as a vice president Prof R Pesek of Czechoslovakia Prof J Peres of France Seifert of the U S and A J Staats of West Germany also were named vice presidents Josef Stemmer of Switzerland was re-elected secretary and Haley was re-elected general counsel

The council also approved formation of an ad hoc committee to review present radiological safety criteria and evaluate their potential influence on future manned space flight and to investigate and report on current channels for international interchange of scientific information in the biomedical and behavioral sciences (See technical report on IAF meeting on p 65.)

Services Reviewing Pilot Lists To Prepare for Impending Cuts

By Larry Booda

Washington—Air Force and Navy are working to pare pilot lists and meet their 99,046 pilot ceiling set by Congress for Dec 31, but the impact is still unclear because Defense Department has not split the mandatory cuts among the services

Air Force, with a surplus of pilots due to the increasing shift from aircraft to missiles, has set up procedures which go beyond past annual reviews by making more minute studies of pilot performance These will be used to set up a priority list so USAF can cut from the bottom when a quota is assigned

Navy, faced with an increased operational readiness commitment with extra attack carriers in the Mediterranean and Far East, has newly increased requirements for pilots Navy says additional units are "under continuing study"

Continuing pressure from Congress has led to stricter criteria being devised Of the pilots recommended for dropping from flight status by last year's Air Force Central Review Board, many captains and majors with future combat potential were included with only a few colonels and no general officers on the list Removal of flight status for these 2,100 pilots was canceled last winter

An aerial flight pay measure, which Air Force Chief of Staff Gen Thomas D White strongly recommended for morale purposes in congressional hearings early this year was scheduled for introduction to the House but was withdrawn by the Administration The measure would provide 5% of flight pay per year for pilots with five or more years of flying status who lose their regular flight pay eligibility, with a maximum of 100% for 20 years (AW June 20 p 140)

The measure has been received with little enthusiasm by nonpilot officers of all the services, especially the Army, who have been joined by members of Congress in objecting to any extension of incentive or 'hazardous duty' pay after flight status is removed

In the past Air Force has emphasized quantitative rather than qualitative performance and total flight hours made an advantage to the individual Now the Central Flight Status Selection Board will concentrate on type of flight hours weighed against the individual potential and officer performance tying together all the qualities of an officer rather than only those of a pilot

Air Force Central Board will meet Oct 10, with the aim of having letters in the mail by Nov 1 to pilots who are to be removed from flight status

In the process of cutting the pilot list use to meet the Air Force quota the Central Board will review only the lowest 25% in terms of total flying hours Of a total of 47,684 pilots 11,680 will be reviewed The screening process does not include those who received their initial aeronautical ratings before July 1, 1941 or those who received their ratings after Jan 1 1955

However, pilots in the group rated prior to July 1 1941, were also recently reviewed by a board of general officers who identified those officers whose aeronautical duties indicated substandard performance These officers will be reviewed by the Central Board

In the 25% under study, several factors automatically excluded pilots from further review These factors included breaks in service which would reduce total flight time, current performance of primary aircraft duty and additional credit for jet flying experience With these exclusions the number remaining for consideration will be 3,799 which the Air Force expects to be well within the mandatory cut quota

A major command may waive review by the Central Board through a recommendation if the officer has satisfactorily performed continuous primary flight duty since Apr 1, 1960 or if the commander simply desires the pilot's assignment to flying duty

The most radical departure in the review procedures has been to inject the consideration of "potential for assignment to positions requiring current and knowledge and experience" The implication is that the more proficient in flying and better versed in doctrine and operations an officer becomes the more valuable he will be in staff and related duties

Even the pilot who has accumulated many flying hours will not escape for non constructive flying time used in the past to exempt the senators of the boards will be closely examined Criteria will distinguish between those officers whose accumulation of flying time has increased their qualifications and those who have not

Criteria set down for major command boards include

• **Rated qualifications** and experience to include types flown during high-flying hours, rates of acquisition instrument flying qualifications and current aircraft experience

• **Non-rated qualifications** and experience and the degree of specialization

• **Combat and operational experience**

• **Initiative, interest and attitude toward flying**

• **Age and physical condition**

• **Career progression**

• **Effectiveness in each of the skills possessed**

• **Training requirements** and an assessment of the opportunities for the individual weighed against the amount of money required to train him

• **Periods and reasons** for inactivity in flying excepting such circumstances as prisoner of war status

• **Future utilization** of pilot

News Digest

Royal Air Force is negotiating with de Havilland Aircraft Co. for the purchase of five Comet 4C aircraft for Transport Command

Stanley Hiller, Jr., president of Hiller Aircraft Corp., and R H Davies, president of The Electric Autolite Co., announced they have signed a contract to merge the businesses of the two companies

Navy has awarded a $168 5 million contract to North American Aviation Corp for follow-on production of carrier-based A3J-1 Vigilante aircraft

Western Electric Co. awarded a $14,455,000 preliminary contract for high power acquisition radars (HIPAR) to General Electric Co. Heavy Military Electronics Department

Hiller Aircraft Corp. and the Electric Autolite Co will merge their businesses, subject to final approval of the stockholders of both companies

Canadair CL-44, the world's first swing tail aircraft, rolled off the assembly line at the company's Montreal plant last week

Short Bros and Harland, Ltd., has obtained British sales rights for products of Beech Aircraft Corp Ultimate intention is to assemble aircraft in Britain later manufacture them if demand is great enough

Polaris Ignition Test

Washington—First underwater ignition test of a modified Navy Lockheed Polaris missile was made successfully last week to determine what the effect on the launching submarine would be if the missile should ignite prematurely Missile had an inert second stage and reduced amount of first stage propellant It was fired from a caisson near San Clemente Island, Calif, with the caisson and surrounding water instrumented to measure shock and pressure waves

DEPARTURE of American Airlines Boeing 707-120 jet from new American terminal at Idlewild involves push-out by tug from passenger loading gate. Engines have been started at the gate. Tug then is detached and plane taxis out.

New Concept in Terminals: Part I

Idlewild Expansion Shows Gains, Problems

Decentralization brings trouble to interline passenger; jetways, conveyors aid ground handling.

By Glenn Garrison

New York—Shakedown period for Idlewild's $150 million passenger terminal complex is well under way with the move of four major U.S. carriers into their own buildings and the facility taxing influx of new foreign-flag jet fleets.

This giant application of the decentralized approach to the jet-paced airport needs of the future involves new advantages and conveniences for airlines and passengers, as well as some new problems and a quota of development bugs. Examples:

• **Innovations** among the new terminals include two-level flow of ground traffic in and out of the buildings, separating arriving and departing passengers and vehicles, "jetways" and an overhanging roof for weather protection in boarding and deplaning, partial mechanization of baggage handling, better presentation of flight information to the passenger.

• **Interline problem** of serious proportions is inherent in the decentralized system, with individual terminals spread around a large oval and connections made chiefly by special bus. Now under intensive study, this problem has resulted in frequent cases of baggage left behind, missed plane connections.

• **Bugs** have included breakdown of the powered jetway devices, damage to aircraft by the jetways, chewing up of baggage in the mechanized systems, terminal damage by faulty ground handling of the jets.

• **Big jet-loads of overseas passengers** at peak periods have jammed the facilities of the International Arrivals Building and adjacent foreign-flag departure buildings. Time and motion studies are in progress to improve baggage-claim bottlenecks in the Customs areas. Expansion of international facilities may be necessary in the near future.

Under the decentralized system at Idlewild, each carrier investing in an individual terminal was free to design its own using whatever ideas it could formulate to improve the passenger's lot and make things easier operationally for the airline.

The new complex is an esthetic revolution to the passenger familiar with Idlewild's unsightly "temporary terminal," used by all carriers before the individual buildings began to enter service. The passengers new environment is spacious and beautiful.

Conventional Designs

Functionally, three of the four carriers with their own completed terminals have followed fairly conventional designs. American, Eastern and United facilities are basically similar to terminals of the past: a central building with check-in lounges, concessions, baggage claim, offices, and the like, and fingers leading from the building out onto the ramp and the aircraft gates. Passenger shoe leather is still the principal means of bringing the passenger and his aircraft together.

The exception is Pan American's almost circular building with its overhanging roof. Aircraft gates are ringed around most of the circle, under protection of the roof. Thus, in effect the finger principle is eliminated and the loading ramp no longer separated from the central building. An important limitation of this design, however, is the problem of expansion potential.

Three of the four terminals are served from the street side by two-level roadways. Arriving ground vehicles discharge—under cover—at the second floor level, while outgoing ground traffic uses the lower level. United's is the exception, with both arriving and departing passenger flow at ground level in and out of the building, and escalators taking the passengers to and from the second floor enplaning and deplaning level.

Loading Bridges

Movable passenger loading bridges connecting aircraft doors with the loading gates are used by three of the carriers in their new operation. These powered devices, under various names such as "jetway," are used by American, Pan American and United. United's is the most elaborate and only United uses two for each jet flight, serving both doors of the aircraft. Also American and Pan American jets nose up to their loading gates, so the bridges are relatively short. United's jetways, on the other hand, telescope well out onto the ramp to meet the plane. But United can taxi in and out whereas the other two carriers push their departing jets away from their gates with tugs.

Eastern is playing a waiting game as far as the expensive loading bridge installation is concerned, using conventional passenger stairs on the open ramp at least for the present.

Handling of baggage at the new

INFORMATION on status of Eastern Air Lines flights is provided by big electronic boards in new terminal. There are seven such boards as passenger aids at various locations.

PROBLEM of interline passenger and baggage connections is serious in decentralized Idlewild terminal area. Interline bus, dubbed "Sputnik" by airline personnel, orbits terminal area, costs 25 cents to ride, carries baggage in rear compartment (right). Driver picks up and deposits prechecked baggage; arriving international passengers look after their own.

'JETWAY' at United Air Lines terminal provides cover for enplaning and deplaning passengers. Two of the devices are used for each jet flight, serving front and rear aircraft doors

'AIRBRIDGE' is Pan American name for its powered passenger walkway from gate to jet door. Loading is accomplished under overhanging roof of circular building.

terminals is speeded by several improvements. All four carriers make some use of conveyor belts, United again by far the most elaborate with a complex network of belts feeding in and out of a central baggage room. Preloaded baggage containers go into the holds of United's DC-8s and American's 707s.

United's belt system, certainly the boldest innovation of the four, incorporates an automatic car which moves up and down the baggage self-claim area, depositing deplaning passengers' bags along the claim counter. Another United device is the "express baggage check-in" counter where excess baggage charges can be automatically computed and paid immediately.

All four of the carriers have given thought to the passenger's need for flight information, with the lighted information board most popular. Eastern has spotted giant boards around its terminal and information is posted electronically by a coordinator from his control tower atop the terminal.

All of the terminals are equipped with built-in facilities for underground hydrant fueling systems, but as yet there is nothing to which to hook them to. Airlines and the Port Authority are still negotiating the financial aspects of a master system from tank farm to terminals. The agency says "hopefully" agreement will be reached by the end of this year.

Ramp Services

Some ramp services are now provided by built-in facilities at the American and Pan American terminals. External power outlets are used by both carriers, normally eliminating ramp vehicles for this purpose.

Besides the four major tenants of the new terminals, other carriers have become subtenants. Delta occupies a section of United's terminal and handles its operations there, and Mohawk has moved in with Eastern. Helicopter carrier New York Airways is scheduled soon to become a subtenant with American.

A number of bugs have developed as the carriers break in their new terminals, some still in the fixing stage. Among the problems has been abuse of baggage in the belt systems when they malfunction. Another is the operation of the powered jetways, which has involved breakdowns and damage.

Interline Problems

But much more serious in the long run is the basic interline problem posed by the widely spaced terminals around the oval.

Under the present system, interline passengers who must move from one terminal to another do so by a special bus, which also carries their baggage (and costs them a quarter). These buses, operated by Carey Transportation, Inc.—operator of the airport limousines and coaches—make their counter-clockwise runs around the area on a scheduled headway of 15 min. at each terminal. In addition to the four new airline terminals, the circuit includes the International Arrivals Building and its adjacent foreign-flag airline wing buildings, and the old temporary terminal where seven carriers still operate.

Airlines report missed passenger connections because of time lost in this merry-go-round, but the big problem is interline baggage. Far too often passengers have arrived at a domestic airline terminal, taken the bus to a carrier in the international building, and departed for foreign shores while their baggage remained on a curb or somewhere else in the sequence.

Interline baggage is hauled in the interline buses, which are equipped with baggage compartments in their rear sections. The Carey driver picks the bags off the curb, loads them in the bus, and deposits them on the curb at their connecting airline terminal.

Baggage Routing

There are five steps in the transfer of interline baggage at Idlewild: plane to baggage room, baggage room to curb, curb-to-curb, curb to airline baggage room, baggage room to plane. With the exception of the curb-to-curb step handled by the driver, various personnel are involved in the process. For example, Trans-Canada Airlines, operating at the old terminal, takes its bags from plane to baggage room. Allied Aviation Service International Corp. is responsible for the baggage-room-to-curb step. At the other end, Allied, Carey, Port Authority Skycaps, or airline personnel may be responsible for the curb-to-baggage room step, depending on the individual arrangements.

A survey made earlier this summer indicated an average of 12 min. per step for bags to make their interline trip, or one hour total. With this average, connecting time for much of the baggage is obviously high.

According to the Port of New York Authority, a three-phase program is under way to speed up this baggage movement. First, Carey recently has assigned a bus for baggage only, and airlines have assigned additional supervisory personnel to monitor the procedure.

Second, a proposal is under study which provides for Carey personnel to handle all the steps except plane to baggage room for all airlines. This would concentrate responsibility on one operator, but it also would cost the carriers more for Carey's services. Third, an airline baggage handling subcommittee plans a time-motion study of the whole procedure as a basis for possible alternatives.

It is generally agreed, however, that the decentralized system automatically limits the improvement that can be made in this area.

Incoming Passengers

Incoming international passengers going through Customs are not affected by the interline system as far as their baggage is concerned, because it is not checked through and they must see to its transfer themselves. However, they do have to take the bus to make connections (or a taxi if they can argue the driver into taking a short haul).

AVIATION WEEK, in a check of passenger reaction to the new terminal complex, found most passengers greatly impressed and favorably so. However, the interline bus brought some sharp criticisms. For example, an Eastern passenger from Boston, riding a bus to National for Miami: "There must be a better way." Another, BOAC to New York, going out via Eastern: "What a mess!"

One passenger, with a French accent, baggage and small boy, boarded the bus after an incoming international flight, was carried a short distance past his destination, the TCA area. He might still be circling the oval if he hadn't asked a fellow passenger where he was and the passenger hadn't looked at his ticket and yelled "TCA" to the bus driver.

Another passenger, who probably experienced conditions at their worst, said he arrived at Idlewild via Scandi-

STAIRS are Eastern's conventional method of moving passengers on and off its Douglas DC-8 jets serving new terminal. Bridges could be installed in future by adding second floor to fingers of terminal building for plane-level loading.

'JET flagship bridge' at American Airlines gate boards passengers through forward aircraft door. Above, an arriving Boeing 707-120 noses into the gate under power. Pilot will stop plane when a guide rail rests against windshield.

CUSTOMS area at Idlewild's International Arrivals Building sometimes is scene of traffic jams. Roped area in background, above, is used to regulate passenger flow

navian Airlines System at 4:10 p.m. Customs delays held him up until 5:15 and he reported surly treatment by the Customs inspectors. Manhandling his own baggage, he found three interline buses tied up at the International Arrivals Building curb but was unable to board any of them because of the jam of passengers. After an argument with a taxi driver in the taxi line (the drivers by law are required to accept short-haul fares but understandably resist these low-yield transactions after a long wait in the line), the passenger flagged a cruising cab and reached Eastern's terminal at 5:50 p.m., 1 hr. and 40 min. after his arrival. He suggested that the unpleasant aspects of his experience represent a sorry impression of the United States that visitors might get at their point of first contact.

Idlewild's International Arrivals Building, and the adjacent wing buildings housing foreign-flag departure facilities (total cost $30 million), were opened in late 1957. Most of the carriers are operating jets for the first time this year, bringing bigger individual planeloads to be handled, and the over-all volume of traffic is constantly rising.

Some bottlenecks have developed in peak hour operation. Gate space for arrivals and departures is then in short supply and the airlines, whose facilities are ranged along the length of each wing building, are not always able to use their normal departure gates, so passengers sometimes are faced with additional walks. Tieups occur in the Customs area when passengers from several flights descend on the self-claim baggage bins all at once. Faster delivery of bags from plane to bin would alleviate this problem, and Pan American has developed a special forklift fitted with a scoop the size of one of the bins to handle its incoming passenger baggage. The problem arises when passengers from one flight stand by the bins, waiting for their bags and another planeload of passengers from a later flight arrive on the scene and also crowd into the bin area and then to the Customs counters with their supermarket-type baggage carts.

The Port Authority has installed a roped-off area at one end of the Customs space as a temporary solution to this problem. Passengers must wait in this area until the bins are cleared.

Some carriers are also running short of waiting room and ticket counter space. Alitalia, for example, has put in a waiting room on the third floor, an area usually used for office space, and has installed an elevator to take the passengers up and down.

The Port Authority says there is plenty of expansion potential built in to the terminal if the airlines want it. The east wing building, now 530 ft. with a 265-ft. arcade extension, could go to 796 ft. The west wing, now 602 ft. with a 220-ft. arcade extension, could go to 818 ft.

However, it would be a complicated project to allocate this additional space to the carriers that want it. An airline now located halfway along one of the wings, for example, wouldn't be helped by the extension of the end of the building. This airline could be relocated in the new space, and the old space divided up to expand the area of the airline's present neighbors, but the project could require some complex shuffling.

On the ramp side, the Port Authority says gates could be added in either of two ways: build new fingers from the end of each wing building, or add perpendicularly to each of the two existing fingers to make them L-shaped instead of I-shaped.

There are presently 10 arrival and 12 departure jet gates, which could be expanded to 14 and 16 respectively, according to the Port Authority.

No expansion is presently planned, the agency said, although "preliminary discussions" have been held with several airlines.

Jets are towed out from all gates but one at the International Arrivals Building. Taxiing in is permitted at some gates. At the old terminal, current procedure is to tow out, although taxi out has been tried experimentally in the past. In getting used to the jet operation, the pilot of one foreign-flag flight forgot the towing requirements, started up and taxied out, filling the International Building with kerosene fumes and necessitating a thorough airing out.

Three more passenger terminals are scheduled to complete the complex. TWA is well along with construction of its strikingly-styled "bird in flight" building and expects it to be in operation in mid-1961.

Northwest Orient Airlines began work several months ago on construction at its terminal site but suspended operations after a complete redesign was decided upon. Completion was planned for next summer, but is now indefinite. The third building is the Port Authority's "union terminal" to accommodate all airlines without their own facilities. A five-way contest to select the architect for this terminal was decided recently on the basis of a design calling for a 600-ft. long, flat-roofed terminal with two fingers, 12 gates and a price tag of at least $9 million. The contest decided the choice of architect (I. M. Pei and Associates) but not necessarily the final design of the terminal. Construction is expected to begin after TWA vacates the old terminal building.

In addition to those airlines presently at the old terminal who have not by then moved out and subleased space elsewhere, the union terminal will house any new carriers to serve the field. Also, some foreign-flag airlines may eventually take space in the terminal to ease the jam in the international buildings.

(Concluding article in this series on expansion of New York International Airport and its resultant problems will appear in the Sept. 5, issue of AVIATION WEEK.*)*

Allegheny No-Reservation Service Permits 50% Cut in Indirect Costs

Washington—Allegheny Airlines estimates that a third of the passengers it carries between Philadelphia and Pittsburgh next year will use its experimental no-reservation service which Allegheny contends can be operated at about half the first class indirect cost per passenger.

Allegheny outlined results of its commuter service experiment last week in a report to the Civil Aeronautics Board in preparation for a Sept. 7 hearing to determine the economic value and impact of the low fare service, which the Board permitted on an experimental basis last October. Outcome of the hearing will have a direct bearing on another application by Allegheny to expand the no-reservation service to proposed nonstop flights between New York and Washington and on the Board's July approval of Allegheny's no-reservation plan for Philadelphia-Boston and Philadelphia-Providence service.

Both Allegheny and Trans World Airlines offer the low cost Pittsburgh-Philadelphia service at a one-way fare of $11.82, compared with rates of $15.79 for rail, $15.58 for auto with two passengers and $9.65 for bus transportation. Allegheny's no-reservation fares are $13 in the Philadelphia-Providence market and $15 in the Philadelphia-Boston market.

Countering TWA arguments that introduction of the new service would dilute the over-all traffic volume in the market, Allegheny told the Board that the combined traffic volume of the two airlines has increased since last October. Local passengers carried by the airlines for a 12-month period totaled 125,556 last October and reached 158,123 by the end of this June. Allegheny estimates the combined annual total will reach 214,000 by the end of 1961.

However, the local service airline's exhibits show that the total last October listed 122,388 passengers for TWA and 3,168 for Allegheny. By the end of June, TWA carried 113,778 local passengers on the route, compared with 44,345 for Allegheny.

Allegheny figures it will carry 91,400 passengers in 1961, compared with TWA's 150,600.

Allegheny integrated its no-reservation plan with its regular service on the route last October and by the end of June 14,647 of the local Pittsburgh-Philadelphia passenger total of 44,345 had used the airline's no-reservation service. In the same period, TWA, which also adopted the plan as a competitive measure, carried 81,865 local passengers, of which 1,816, or 2.2%, flew on the no-reservation plan.

Elimination of a multitude of reservation and ticketing procedures has resulted in an indirect operating expense of $3.58 per passenger for no-reservation service, compared with $8.80 for first class, Allegheny reported.

Figures presented by the airlines for the first six months of this year showed total indirect expenses of $44,508 to handle 12,423 no-reservation passengers, compared with $196,829 indirect cost for 22,355 first class passengers. More than $42,000 was saved through the elimination of reservation and sales procedures while savings on such items as advertising, publicity and traffic servicing produced cost reductions ranging between 50 and 85%, Allegheny economists calculate.

On a fully allocated expense basis, Allegheny forecasts that each no-reservation passenger will contribute $1.53 to the airline's profit, after provisions for direct and indirect expenses, taxes and a 12.5% return on investment.

FAA'S Loading Bus for Dulles Airport

Model of mobile lounge vehicle selected by the Federal Aviation Agency for use at Dulles International Airport shows utilitarian design of the passenger bus, 10 of which are expected to be ready by July 1, 1961. Powered by two 170 hp. gas engines, the lounge will have dual controls for operation from either end. Designed normally to carry between 60 and 90 passengers, the 38 ton lounge is 54 ft. long, 15 ft. wide and 17½ ft. high. Chrysler Corp. is building the chassis for the first prototype in Detroit and the Budd Co. is building the body in Philadelphia. Aircraft loading end of the lounge has twin loading ramps which can be adjusted for either fore or aft from a distance of seven feet from the aircraft. FAA plans to have a fleet of 20 mobile lounges at Dulles by 1965.

Eastern Policy Changes

New York—Basic reorientation of Eastern Air Lines policy under President Malcolm MacIntyre has resulted in an average drop of 65 million monthly passenger miles over the airline's system since Jan. 1.

Under a continuing re-evaluation of policy to meet changing circumstances, largely due to increased competition and the impact of jets, Eastern last April instituted the service cutbacks, which in large part involved flights running at 30% or lower load factors. The move resulted from a lengthy study Eastern had made and is said to have produced a tighter scheduling picture with improved load factors.

The increased competition of the past few years along with the impact of jet capacity, made Eastern's previous high-frequency policy in many markets marginal because of the load factor drops. The April changes were at various stations throughout the system. All Lockheed 749 flights, some Martin 404 and some Lockheed 1049 flights were eliminated by the cutback.

Another study is in progress, a spokesman told Aviation Week, to analyze the role of smaller stations in Eastern's route pattern. Eastern has traditionally operated a large number of short-haul flights, being in effect partially a feeder airline as well as a trunk operator. The economics of the short haul operation are getting a thorough evaluation in the study.

The Eastern president met last week with pilots to discuss fundamental policy changes. A pilot group recently criticized publicly the new Eastern management. Equipment retirement and schedule changes have resulted in pilot furloughs (AW June 27, p. 38). However, the public dispute reportedly did not come under discussion at the meeting. MacIntyre also has met with various other groups of the airline's personnel.

As discussed at the meeting, Eastern still has strong hope for a transcontinental award in the Southern Transcontinental Route Case. MacIntyre denied any interest in mergers—except "with a bank" to obtain money for new Boeing 720 and additional medium range jet equipment.

Proposed FAA Noise Rules Challenged

Washington—Proposed Federal Aviation Agency regulations aimed at reducing jet engine noise around airports fall short of their intended goal, a Port of New York Authority noise consultant charged last week.

Dr. Leo L. Beranek, president of Bolt Beranek and Newman, Inc., and a Port Authority consultant, said the proposed FAA noise reduction rules will, on the average, result in higher noise levels in the communities than are allowed by the rules now in force by the Port of New York Authority. Dr. Beranek discussed noise rules in a statement filed with the House Committee on Science and Astronautics, which held hearings last week on research progress in noise reduction.

FAA Administrator Elwood R. Quesada disagreed with Beranek, calling the FAA rules the best solution when all factors are considered. Quesada said the proposed noise rules will be published as regulations "within a week."

"The rules for takeoff simply say that all fixed-wing aircraft climb to 1,500 ft. as rapidly as practicable ... an exception is provided in the rule for certain aircraft which are capable of producing less noise in a slower climb rate. In our opinion," Dr. Beranek said, "a successful program of noise control for a community must place actual limits on the noise produced by aircraft as they pass overhead. It is easily demonstratable that simple compliance with the FAA rules will permit noise levels far in excess of those reasonable in the neighborhoods around New York International Airport."

In placing limits in "perceived noise decibels," he said, under certain conditions aircraft might have to depart with less than a full load since the weight of the airplane is one of the most important factors governing aircraft noise levels. "The loss of possible revenue in the interests of noise control must simply be accepted as one of the costs of operating a modern transportation system," he said.

Dr. Beranek also said the Federal Aviation Agency should provide more stringent regulation of scheduled night takeoffs over communities than of daytime takeoffs.

In addition, Beranek said, the FAA should "today set mandatory rules for the operation of all present military and future commercial supersonic aircraft to avoid positively any operations near major cities that would result in even moderate sonic booms."

"Among other facets of the future noise problem," he said, "the overall picture suggests need for research in jet engine noise reduction, research in presently unknown or little-known methods of propulsion that might be applicable to aircraft movement."

FAA Administrator Elwood R. Quesada told the space committee that there are no immediate and dramatic means of completely stifling the noise that accompanies essential air transportation.

"Despite this," he said, "increasingly effective methods of reducing and tolerating noise are being developed and put into effect. With advanced planning and the concerted effort and cooperation of the industry, the airport operators and the affected communities, we believe that the noise nuisance can be held to an acceptable level commensurate with progress in air transportation.

"The FAA has recognized that objectionable noise emanating from aircraft operating into and out of some airports has reached a level of seriousness that warrants the development of specialized research studies, operation techniques and procedures designed to alleviate noise levels and promote effective airport and community relations. We consider the noise problem next to safety, is the most critical one we face."

Quesada said that headway has been made in reducing noise on the ground by using jet silencing screens and noise suppressors at maintenance and overhaul bases. To provide a measure of relief from flight noise, he said, the FAA is requiring as much distance as air traffic safety will permit between aircraft taking off and landing and the persons within the hearing range of the engines through issuing new traffic control rules establishing a system of preferential runways and changing operating techniques.

Bernard A. Schmeckrath, engineering manager of Pratt & Whitney Aircraft Division of United Aircraft Corp., told the space committee that new standards of noise evaluation must be formulated before any organization can do a technically sound job in reducing noise to acceptable levels.

Under present methods of measuring aircraft noise levels, he said, two distinctly different sounds, one more annoying than the other, are judged to be on the same decibel level.

"Should a situation develop, as it well may," he said, "that laws, ordinances or regulations are enacted based on present standards, jet aircraft operations could be severely hampered."

Schmeckrath said engines such as the JT3D turbofan engine produced by Pratt & Whitney "will go a long way toward alleviating the takeoff noise problem." It reduces the exhaust noise generation while increasing the maximum thrust available for takeoff and initial climb so that the plane may be able to pass over the neighborhood at a higher altitude, he said.

Air-India 1049 Converted for Cargo

Air-India International Lockheed 1049 Super Constellation was converted to cargo configuration in 10 weeks by Lockheed Aircraft Service, Ontario, Calif., which also converted a 1649A Constellation for Lufthansa (AW Aug. 1, p. 49). Empty weight of Air India's conversion is 71,042 lb.; maximum gross weight is 137,500 lb.

Riddle Seeks Funds For Logair Contract

Miami—Riddle Airlines, Inc., will offer $2.25 million worth of 6% subordinated convertible debentures to the public as part of a refinancing program aimed at acquiring operating capital to fulfill an $8 million Logair contract effective through fiscal 1961.

Already committed to purchase five AW 650 twin turboprop freighters, Riddle plans to use an unspecified portion of the proceeds to purchase additional aircraft in anticipation of other military contracts. Each AW 650 Argosy will cost Riddle about $1.31 million (AW July 4, p. 40).

Underwriter for the bond sale is James H. Price & Co. of Coral Gables, Fla. In addition, the underwriter and William R. Price of New York will offer 1,115,000 shares of Riddle common stock from their own accounts in the over-the-counter market. The two parties, with Securities & Exchange Commission permission, will offer varying amounts of this stock as dealer-broker discounts and commissions in the bond sale.

For each $100 debenture sold, the underwriter will receive a 10% commission. Moreover, Riddle has agreed to sell Price & Co. five-year warrants for 200,000 common shares at 45 cents per share. Price & Co. will pay one cent for each warrant.

Riddle now has 11,430,905 common shares outstanding.

The carrier has been promised delivery of the five AW 650s by February 1961. With Civil Aeronautics Board approval, they will be purchased through an independent Riddle subsidiary chartered in Puerto Rico, one of the carrier's prime markets. Riddle then will lease the aircraft for a sum equal to the subsidiary's payments to the manufacturer.

U. S. Wins New Routes In Mexican Bilateral

Washington—U. S. won authority to operate three new routes, including an all-cargo route, in the new U. S.-Mexico bilateral air transport agreement.

In return, the three-year pact (AW Aug. 15, p. 38) permits Mexican carriers to fly two new routes to the U. S. to serve Dallas-Ft. Worth and to fly beyond New York to Europe on the Mexico City to New York route.

Civil Aeronautics Board already has approved applications from Braniff Airways to serve one of the passenger routes from San Antonio, Tex., to Mexico City and from Aerovias Sud Americana, an American-owned airline, for a cargo and mail route from Miami and Tampa, Fla., to Merida and Cozumel, Mexico, and beyond. CAB expects to choose a carrier for the third route, from Miami and Tampa to Mexico City via Merida, in the near future.

Terms of the agreement create two new Mexican airline routes—from Monterrey to San Antonio, Tex., and from Hermosillo to Tucson, Ariz., via intermediate Mexican cities. Changes in the existing route pattern also will allow Mexican carriers to fly from Mexico City to Washington and New York and beyond to Europe. A second revision permits service from Mexico City to Chicago via the intermediate points of Dallas and Ft. Worth, Tex.

Ghana Buys Il-18s From Russia

Soviet sales campaign to sell Russian transports outside the Iron Curtain bloc has resulted in an order for four Il-18 turboprop aircraft by Ghana Airways, national airline of Ghana.

Delivery dates and price were not disclosed but both were believed to be highly favorable to Ghana. Aircraft probably will be used over Ghana Airway's routes within Africa and to the Middle East.

Capital Reports Loss In First Six Months

Washington—Capital Airlines reports a $7,108,739 net loss for the first six months of this year, a substantial increase over the $624,000 deficit in the same period last year.

Operating revenues dropped from $54.9 million during the first six months of 1959 to $52.1 million for the same period this year, while operating expenses increased to $57.1 million compared with $54.7 million for the 1959 first half. Increases of $1.1 million were recorded for maintenance and repairs and more than $500,000 for flying operations.

Expenses included $2.4 million to cover the costs of the airlines' now abandoned program of financing new flight equipment and retirement of nine Lockheed 049 Constellations.

The average Capital load factor for the six month period dropped from 59.8% to 53.2% and revenue passenger miles fell from 825,226,000 for the first half of last year to 774,585,000 for the same period this year.

Revenue plane miles flown by the airline dropped from the 30,924,182 mi. recorded in the first six months of last year to 30,125,208 for the first half of this year.

Il-18 Crashes En Route

Soviet government commission has been set up to investigate the causes of the crash of an Aeroflot Il-18 en route from Cairo to Moscow, killing 27 passengers and crew including several African political leaders. Accident occurred near Kiev on a regularly scheduled flight.

Swiss Charter Carrier Will Backup Swissair

Basle, Switzerland — Balair, Ltd., Swiss charter carrier 40% owned by Swissair, intends to inaugurate service between the United States and Europe as soon as the Civil Aeronautics Board approves its application.

Kurt Herzog, one of Balair's two managing directors, reports that the charter service largely will be used as a backup for Swissair, with charters being substituted for scheduled flights during periods of peak demand.

Balair plans both cargo and passenger charters, with emphasis on the latter.

Assuming CAB approval, initial service will be with two Douglas DC-4s that Balair now has available. Two Douglas DC-6Bs, which Balair is purchasing, will be used when delivered, probably before the end of this year.

Italians Say U. S. Jet Invaded IFR Corridor

New York—Pilot of the Pan American World Airways jet involved in a recent near miss incident at Rome's Ciampino Airport has been fined by the airline for not adhering to his manual.

His approach was VFR and he was required to avoid the area of a holding beacon where the near miss incident occurred.

A British European Airways Viscount approaching IFR saw the Pan American jet and pulled up sharply, reportedly causing slight injuries to some passengers.

There is some dispute as to whether the tower advised the Pan American pilot to avoid the holding beacon area before or after the incident. In any case since the manual required such avoidance the pilot was fined. The fine was less than the $500 maximum under the circumstances, according to the airline.

The Italian Defense Ministry issued a statement absolving the airport personnel of any responsibility for the incident.

The Pan American pilot was "arbitrarily" nearing the corridor reserved for instrument approaches, the statement said.

USAF Continues Congo Airlift

Wiesbaden, Germany—U S Air Force Douglas C-124 cargo planes are scheduled to ferry a contingent of 243 Pakistani troops and 18,000 lb. of equipment from Karachi to Leopoldville this week as new nations answer the UN call for military aid to support operations within the unstable Congo Republic. (Operational details of the airlift are described in a story on p. 82.)

Pakistani troops, representing the 13th foreign nation whose soldiers have boarded USAF aircraft bound for the Congo since the emergency UN airlift began July 15, will be transported to Leopoldville with their equipment aboard four Military Air Transport Service C-124s flying one sortie each.

The lift originally was scheduled to begin early last week. It was delayed at the request of the Pakistani government because troops could not be ready in time. Request came after three C-124s were airborne from Europe to Karachi. The aircraft were then diverted to aid in the airlift of Ethiopian troops from Addis Ababa to the Congo.

Another troop lift postponed by unavailability of troops called for transport of 600 Guineans and an unspecified amount of equipment from Conakry to Coquilhatville. It was originally scheduled to begin on Aug. 16, but Wiesbaden headquarters of U S Air Forces in Europe had not received a definite date by late last week. Twelve Lockheed C-130 turboprop transports of the 322nd Air Division based at Evreaux Air Base, France, are scheduled to fly in the troops.

Pakistan and Guinea moves were the last two UN troop lifts to the Congo still on Air Force books last week, but USAF expected more flights as nations responded to UN requests.

An Air Force spokesman said USAF is prepared to continue the airlift with the 322nd C-130s and MATS C-124s "for six months or more" if needed. However, the airlift is not expected to regain the heights of the initial maximum-effort push between July 15 and early August during which more than 9,000 troops and 400,000 lb. of equipment were flown into the Congo (AW Aug. 15, p. 32).

Airlifts completed last week included:

- **736 Irish troops** and 288,000 lb. of equipment from Dublin to Kamina, former Belgian military preserve in troubled Katanga province in 21 C-124s. Original estimates had called for the transport of 716 troops (AW Aug. 22, p. 45) to bolster the force of 760 Irish soldiers already in the Congo.
- **520 Troops** of the United Arab Republic and 210,000 lb. of equipment from Cairo to Coquilhatville in nine C-130s flying a total of 17 sorties. Original UAR offer of 1,000 troops was later scaled down to 520.
- **203 Tunisian troops** and 12,000 lb. of equipment from Tunis to Luluabourg in the Central Congo in three C-124s.
- **760 Ethiopian troops** and 100,000 lb. of equipment from Addis Ababa to Stanleyville in seven C-130s and 16 sorties.
- **759 Moroccan troops** from Sidi Slimane Air Base, Morocco to Elisabethville, capital of Katanga province in 13 C-124s.
- **91 Indian troops**, mostly supply personnel and 7,000 lb. of equipment from New Delhi's Palam Airfield to Leopoldville.

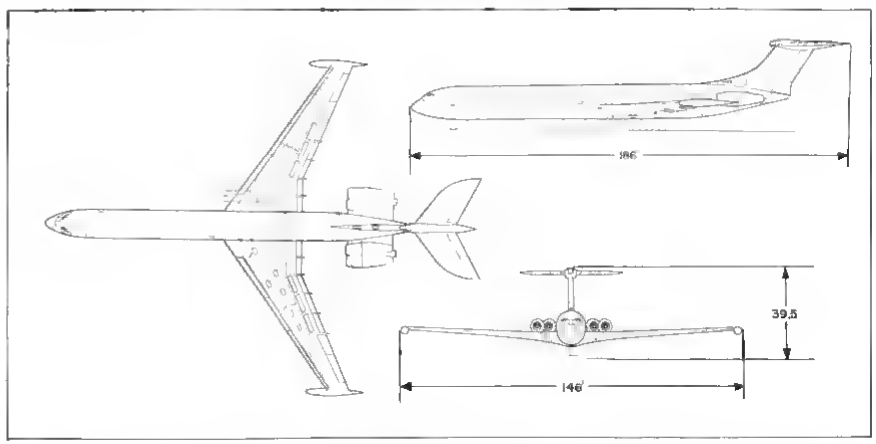
Threats to Crew

Geneva—Belgian pilot of a Sabena Belgian World Airlines aircraft under charter to the UN was arrested and jailed last week and a Swissair Douglas DC-6B crew was threatened by mutinous Congolese troops who apparently still are not fully under control.

The Belgian pilot was arrested at Luluabourg and Sabena spokesman in Brussels said late last week they assumed he was still being held. Other details, including the type aircraft he was piloting, were not available. Sabena aircraft under contract to the UN were used to fly the airline's routes within the Congo before the present crisis. These included Douglas DC-4s, Convair 440s, DC-3s and C-47s.

Swissair crew was apparently mistaken for a Belgian one and was threatened in Leopoldville. The crew had to be escorted to the airport under UN guard.

The crew was not physically molested and the aircraft returned to Zurich Aug. 24. Flight was the last of a series of cargo flights Swissair has flown within the Congo under UN contract.



Super VC.10 Has Optional Pod for Freight or Spare Engine

Vickers-Armstrongs Super VC 10 turbojet transport will be designed to carry an optional pod under the right side of the wing for freight or for accommodating a spare Rolls-Royce Conway 42/2 bypass engine (20,250 lb. thrust). British Overseas Airways Corp. has ordered 10 of the 212 passenger Super VC 10s, which are expected to enter service about 1964-65 (AW July 4, p. 46).

AIRLINE OBSERVER

▶ Soviet Russia has no intention of joining any international airline organizations at this time, according to Lt. Gen. Georgiy Semenovich Schetchikov, first deputy chief of the main administration of Russia's civil air fleet, and head of a 10-man delegation which last week completed a tour of U. S. civil aviation facilities. He said that the time is "not ripe" for the USSR to join either the International Civil Aviation Organization or the International Air Transport Assn.

▶ **Finnair's present use of a two-pilot minimum crew on the Snd Caravelle twin turbojet transport will probably be used as an example by the Air Line Pilots Assn. in its efforts to modify Federal Aviation Agency regulations requiring a flight engineer on all aircraft over 80,000 lb. gross takeoff weight. However, the argument could be nullified by crew configurations on other European carriers which fly the Caravelle with either two pilots and an engineer or with three pilots, one of which is engineer qualified.**

▶ Aeroflot again is announcing that its four-turboprop Tupolev Tu-114 will go into regularly scheduled service "in the near future" following an exceptionally long proving period of nearly two years. Most major difficulties with the aircraft have been solved, the airline said, but Soviet aviation publications report that ground handling of the heavy transports still seems to be a problem, pointing out that Aeroflot's highly touted new 300 hp. MAZ-541 tug recently was unable to get a fully loaded Tu-114 moving from a rolling start.

▶ **British aircraft manufacturers are increasing their sales programs in Brazil in anticipation of Brazilian government passage of a bill which would grant the country's airlines $10 million a year for the purchase of new equipment for the next five years.**

▶ Revision of current minimum airfreight rates, now being studied by the Civil Aeronautics Board, is expected to hinge on the performance of the Canadair CL-44 ordered by several cargo carriers for delivery next year. In a recent order of investigation, CAB noted that faster development of airfreight may have been retarded because of present high rates, while lower rates may depend upon the airlines' use of more efficient all-cargo aircraft. On the basis of industry comments, the Board will decide whether to hold a public hearing this fall or defer further action until operating experience with the new aircraft is available.

▶ **Air Line Stewards and Stewardesses Assn. sought an international charter from the AFL-CIO last week after the Air Line Pilots Assn. earlier voted to revoke the permanent charter of the union as an affiliate of ALPA. Grounds for the revocation cited by the pilots included charges that ALSSA failed to cooperate with the parent union and attempted an affiliation with the International Transport Workers Federation without ALPA approval. ALSSA has since polled 10,000 ALPA members to get their opinion of its actions.**

▶ Ceylon was granted approval of a $3.2 million loan last week by the Development Loan Fund to aid in the construction of a new international airport at Katunayake, 24 mi. north of Colombo.

▶ **Malev, the government owned airline of Hungary, which last May placed Russian built Il-18 turboprop transports in long haul service, is now doing over 60% of its total business on international routes, compared with less than 42% in 1957. Soviet publication Grazhdanskaya Aviatsiya notes that the airline expects to be carrying 226,000 passengers annually by 1965 and plans to establish a helicopter service on domestic runs approaching 150 mi. when the over-all traffic volume is sufficient.**

▶ Civil Aeronautics Board warned National Airlines against misleading advertising last week with a cease and desist order concerning a 15 day vacation package which included a $70.20 New York-Miami round trip fare. Eastern Air Lines complained that advertising created the impression that this price covered all expenses of the vacation instead of just the air fare, and the CAB agreed.

SHORTLINES

▶ **Air Line Pilots Assn.** survey's preliminary results show that of the 569 U. S. airports certificated for airline use by the Civil Aeronautics Board, only 185 are equipped with instrument landing systems, 53 have a complete set of centerline approach lights and 36 have a combination of centerline approach lights and flashing sequence systems.

▶ **American Airlines** will begin New York-Mexico City DC-7F all-cargo service Sept. 1 operating five flights a week with stops at Detroit, Chicago, Dallas and San Antonio.

▶ **American Medical Assn.** has formed a committee to investigate the new physical examination prescribed for airline commercial and private pilots by the Federal Aviation Agency. AMA move followed pilot complaints that the physical exam, which went into effect June 15, was a departure from traditional doctor-patient relationship.

▶ **British Overseas Airways Corp.** will introduce Boeing 707 service on routes between Chicago and Detroit and London Sept. 20 with a schedule of two flights a week.

▶ **International Civil Aviation Organization** has issued five sections of a new manual designed to give airport operators guidance in planning facilities for civil aircraft and especially for turbine-powered transports.

▶ **New York International Airport** cargo facilities will be expanded by construction of two additional airfreight buildings, with spring of 1962 the scheduled completion date. The $2,864,000 project is needed, according to the Port of New York Authority, to handle cargo traffic at Idlewild, which has increased from 160 million lb. in 1949 to an estimated 475 million lb. in 1960.

▶ **Three million dollar instrument** room in the tower of Newark, N. J., Airport was commissioned last Wednesday by the Federal Aviation Agency. Four radar scopes on the IFR deck are manned by a supervisor and six controllers to provide 24 hr. radar coverage of Newark area traffic.

▶ **Transports Aeriens Intercontinentaux** (TAI) plans to schedule its first Douglas DC-8 on the 12,291 mi. route from Paris to Noumea, New Caledonia, with service beginning Sept. 11. Flight time will be 27 hr. with intermediate stops at Athens, Karachi, Bangkok, Saigon, Darwin and Sydney.

TRANSIT IIA satellite, with piggy-back solar radiation satellite on top, undergoes a spin test at left. Fitting trial for jettisonable fairing of Transit IIA shows how struts on top of Able Star vehicle would support the spin table on which payload is mounted.

Able Star Works as Second Stage Booster

By Irving Stone

PROPULSION portion of Able Star vehicle showing thrust chamber, nozzle and helium pressurizing spheres is seen above. Integral spaghetti tubes, for circulation of oxidizer for regenerative cooling, are shown on the nozzle's narrower portion, which has an expansion ratio of 20:1. Nozzle extension gives the nozzle a 40:1 expansion ratio. Pitch jets are on brackets located diametrically opposite (top and bottom).

Los Angeles—Able Star vehicle has turned in two successful performances in its initial applications as a second-stage space system atop the Thor first-stage booster.

Embodying integrated control for trajectory and injection of satellite payloads into orbit, it represents a state-of-the-art sophistication to eliminate protracted design, development and manufacturing phases. Able Star vehicles demonstrated the first successful propulsion system shutdown and restart capability in space as they boosted the Navy's Transit 1B navigation-aid satellite and Transit IIA navigation-aid and solar radiation piggy-back payloads into orbit around the earth (AW Mar. 28, p. 76 and June 20, p. 76).

Engineering development on Able Star took six months. Delivery of the first vehicle was made about three months later. There was only one preliminary flight rating test (series of static runs). The second Able Star fabricated was put into service as the second-stage space booster which successfully put Transit 1B satellite into orbit.

Basic philosophy underlying the development of Able Star was to develop a single stage embodying the performance capabilities of a second stage and third stage combination as used in the earlier Thor Able series. To meet this rule, Able Star was designed as an optimum second stage, considering the propellants used for use with the Thor IRBM as a basic booster.

Able Star's basic propulsion system, the Aerojet AJ10-104, essentially is built of proven components and is the successor to Aerojet's AJ10-101, which served as the original Able series second stage, in turn the successor of the original Vanguard second stage.

The aluminum thrust chamber assembly is regeneratively cooled with oxidizer which circulates up to a nozzle station having an expansion area ratio of 20 to 1. Main oxidizer lines feed spaghetti tubes in this portion of the nozzle, with the tubes, in turn, feeding back to the chamber for mixing with the fuel to produce the hypergolic reaction. An uncooled extension of the nozzle, made of titanium, expands to produce a final area ratio of 40 to 1.

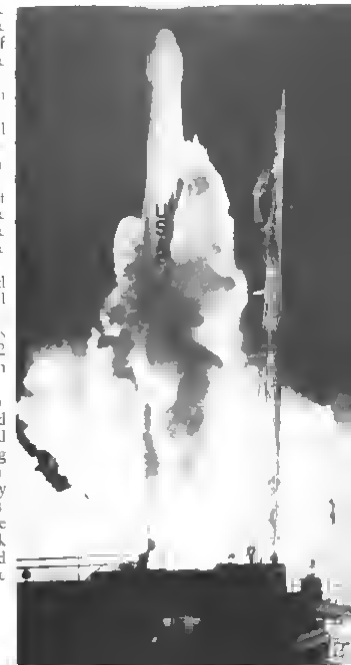
Operating at a pressure of 206 psia, the thrust chamber is rated at 7,890 lb. vacuum thrust. Propellant is the hypergolic mixture of inhibited red fuming nitric acid (IRFNA) and unsymmetrical dimethylhydrazine (UDMH) fed to the chamber at a total flow rate of 28 lb./sec. with a nominal stable oxidizer to fuel mixture weight ratio of 2.8. Nominal instantaneous specific impulse is 278 lb.-sec./lb. and the system is designed to deliver a minimum total impulse of 2,300,000 lb.-sec. These performance parameters (total and specific impulse) have been exceeded slightly in the space experiments.

Helium pressurizing gas is stored at a pressure of 4,350 psig in three spherical titanium bottles located in the aft compartment. Propellant tanks are pressurized at the firing signal.

Propellant tank assembly is designed to give optimum gross weight coupled with optimum total impulse for a second stage to be used with the Dinghy Thor. Tankage capacity is about 2.2 times that of the AJ10-101 propulsion system.

For high strength-to-weight ratio, tank material is made of heat-treated AISI 410 stainless steel with welded construction, with tank wall also serving as the vehicle skin. An inter-tank membrane head divides the tank assembly into oxidizer and fuel compartments. Sheet metal anti-vortex baffles are located at oxidizer tank and fuel tank outlets. The tankage may be adapted to a variety of missions by varying the

ABLE STAR vehicle is shown being hoisted for positioning on Thor booster in background (left). Blast holes seen in interstage structure (right) normally are covered with blast band which is blown off. Holes relieve pressure inside the interstage structure to prevent damage to Thor autopilot and Able Star during the separation phase while Able Star is firing. Launch of Thor-Able Star is seen below.



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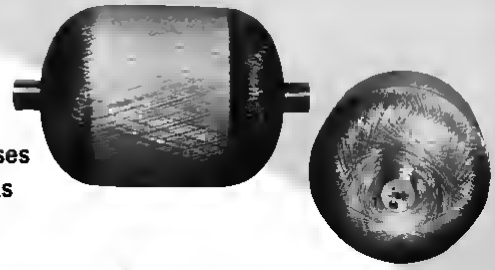

- **Solid Rocket Motor Cases**
- **Liquid Propellant Tanks**
- **Other Pressure Vessels**

The TAPCO Group is now producing pressure vessels of higher quality than has previously been possible in the industry. Advent of the unique electronically-controlled helical winding machine illustrated at left is part of the reason.

This machine, designed and built by the TAPCO Group, allows complete, automatic control of the rate, speed, stress, and winding angle of each individual filament, and infinite adjustment over any given operable range. The usual need for design compromise is eliminated, and the following advantages are obtained:

- Uniform finish of end domes—elimination of material pileup.
- Reduction of weight.
- Maintenance of exact filament pitch—no bends, no kinks in fibre.
- Optimum winding angle allowed.
- Optimum strength-density ratio maintained.
- Each fibre held under identical stress, even around end domes.
- No fibre shifting when vessel is loaded.

TAPCO is capable of winding pressure vessels 72" in diameter to virtually any length, approaching within 10-15% of theoretical optimum stress levels around end closures, and 1-2% along cylindrical portions.

This capability is a new high point of TAPCO's seven years of experience in reinforced plastics. Programs for the missile industry include the Pershing TEL blast deflector, plastic nozzle components for all stages and all motors under development for an advanced missile program, the booster nozzle and internal insulation for Super Talos, and plastic components for the Polaris second-stage nozzle and the Sidewinder booster motor.

Each reinforced plastics project at TAPCO is handled by an outstanding project engineering team under the direction of a program manager. Each customer deals directly with the manager of his program—the man responsible for product quality and performance, for meeting delivery dates, and for introducing continuous cost-reduction programs after startup.

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length of the cylindrical section between the hemispherical tank heads This can be done by adapting a wider single sheet between heads, because tank design is sufficiently strong to withstand loads which would be imposed with increased tankage length.

An attitude control system in Able Star provides restoring moments to maintain required orientation throughout the trajectory during powered phases and during the coast period between first and second burning periods of Able Star

During the powered phase, pitch and yaw control is obtained by gimbaling the thrust chamber by means of a hydraulically operated actuation system Working pressure is 1 050 psig for a maximum output force of 950 lb , with a moment arm of 6 in Two servo actuators in the pitch and yaw planes transform on demand, the constant hydraulic pressure supplied by a motor-driven pump into the force required to move the thrust chamber about the gimbal monoball ±3 deg in a "square" pattern

In the coast portion of the trajectory, pitch and yaw control is obtained by use of nitrogen gas stored in six bottles under 4,000 psig pressure Four solenoid valves feed the nitrogen to the pitch or yaw jet nozzles For shortened or extended attitude control impulse fewer or more bottles could be used, or the system could be omitted completely if no separate attitude control were required

Powered phase and coast phase roll control also is obtained with pressurized nitrogen and solenoid valves which admit, on signal, gas to two pairs of roll jet nozzles

Nitrogen Exhoust

To settle the propellant over the outlets in the tanks after the coast phase which introduces a zero-g condition, nitrogen is exhausted through a pair of longitudinal acceleration jets, just before restarting the engines Also, the propellant lines are fitted with check valves to prevent propellant backfeed and emptying of the main feed lines, to ensure an immediate propellant supply for the restart

Coast attitude control subsystem thrust for the pitch and yaw jets is 4 lb Longitudinal acceleration jets for settling the propellant after zero-g coast flight have a thrust value of 4½ lb The roll jets during powered flight have a thrust value of 4 lb Since the roll control moments are less during the coast phase than in the powered phase, thrust value of the roll jets during coast is reduced to only ½ lb This lower value promotes conservation of nitrogen, consequently saves weight Since the coast phase is relatively long compared with the powered phases, this weight saving in nitrogen gas is considerable

The two pitch jets are located on brackets positioned diametrically opposite on the vertical axis at the aft end of the engine, above and below the area of the helium bottles Brackets located diametrically opposite on the horizontal axis at the aft end of the engine accommodate the two yaw jets and the four roll jets (two on each bracket), as well as the two propellant-resettling jets

The compact and space-saving design provides for mounting of the gimbal actuation, the pneumatic pressurizing system, and many of the attitude control subsystem components on removable panels in the aft transition compartment of the engine. This allows easy access for maintenance, leaves free the forward portion of the vehicle for use as an equipment compartment

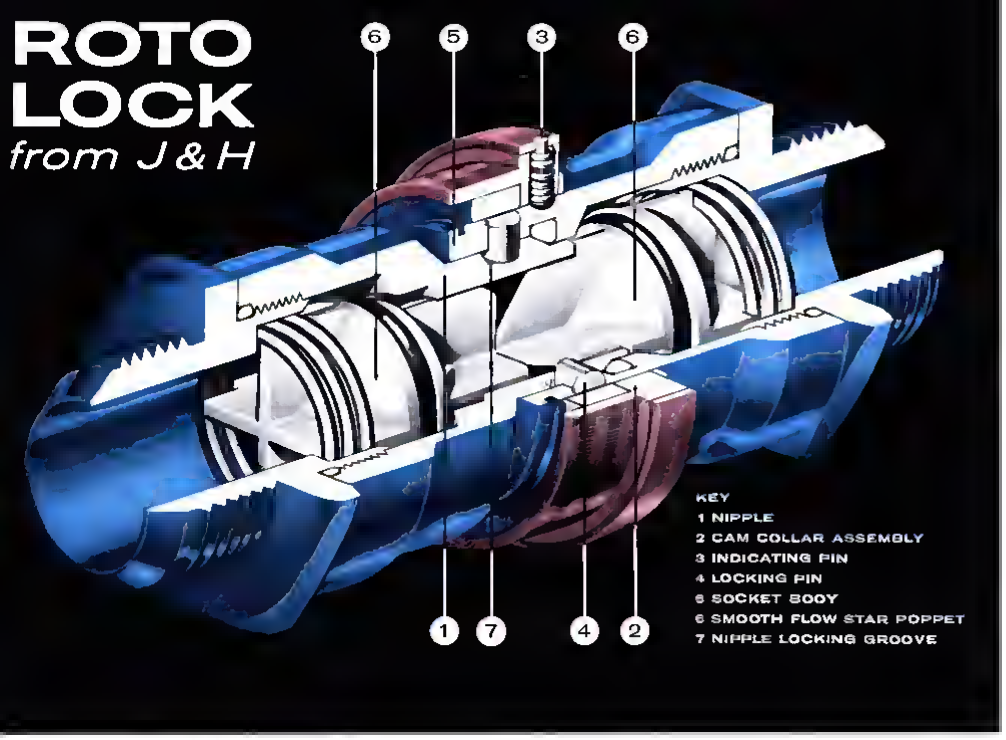
Space Technology Laboratories' systems engineering and technical direction responsibility for the over-all Able Star vehicle covered a broad area of development

- Analytical studies required for stresses staging, stability, control, aerodynamic aspects, propellant sloshing, and heating
- Integration of electrical and mechani-

AJ10-104 Performance, Weight & Envelope Data

Total Impulse	2 3 x 10⁶ lb sec
Thrust	7,890 lb
Static Mixture Ratio	2.80 ± .06 lb. oxid /lb fuel
Chamber Pressure	206 ± 6 psia.
Specific impulse	278 lb -sec /lb
Thrust Coefficient	1.77
Propellant Flow Rate	28 36 lb /sec.
Nozzle Throat Area	21 64 sq. in.
Nozzle Area Ratio	40 1
Oxidizer Tank Volume	65 51 cu ft
Fuel Tank Volume	47 01 cu. ft
Helium Tank Volume	11 34 cu. ft
Nitrogen Tank Volume	0 89 cu. ft
Length, Over-all	177 68 in
Diameter, Propellant Tanks	54 8 in
Diameter, Separation Plane	63 6 in
Dry Weight, Basic System	920 5 lb *
Total Propellant Capacity	8,474 3 lb.
Helium	29.2 lb
Nitrogen	14 8 lb
Hydraulic Fluid	1 3 lb
Residual Propellants	24 0 lb
Nominal Residual P.U. (bias)	20 4 lb
Residual Helium	29 2 lb.
Residual Nitrogen	2 4 lb
Transient Propellants	73.1 lb.
Coast Attitude Control	37 5 lb *
Destruct Subsystem	3 6 lb *
Instrumentation	5 5 lb.*
Restart Acceleration System	1 70 lb *
AJ10 104 Dry Weight (sum of astersked items)	984 1 lb

ROTO LOCK from J&H



High-pressure handling...low-pressure drops...long service... 3-way open-close signal...make ROTO LOCK top-ranking coupling

The ROTO LOCK quick-connect coupling, technical features of which are outlined briefly here, has been proved in service in missile, aircraft and ground support applications. Its performance has been outstanding.

Jack & Heintz, a prime designer and manufacturer of secondary-power systems and components, now makes this superior unit more broadly available not only for its many immediate applications, but for the many advanced applications which can benefit from its capabilities by adaptations in design.

Every prime need of quick-connect coupling users, as indicated by surveys, is met by new ROTO LOCK. These are the most important improvements it brings immediately to the designers of fluid-handling systems.

Ease of connection—one quick twist of actuating collar connects; one twist in opposite direction, disconnects.

Higher fluid pressures—1" coupling proof rated at 3000 psi in aluminum. Higher ratings dependent on size and material.

Lower pressure drops—less than 3.1", H_2O at 6 gpm for the 1-inch coupling.

Longer service life—"balanced-load" character of locking mechanism doubles service life compared to conventional units.

Longer seal life—simplified sealing reduces wear, speeds replacement, eliminates secondary seals.

Better coupling condition signal—indicating mechanism provides sensory, audible *and* visible signal of open or coupled.

Adaptability to need—will handle any fluids from air through exotic fuels; can be made in wide range of materials, including plastics; easily adaptable to special requirements.

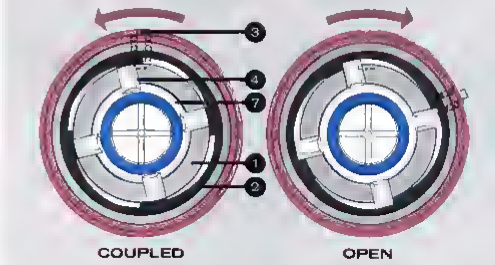
How these improvements are provided by ROTO LOCK is shown on this page. Specific application data and performance analyses are available on request. Sizes and designs available for immediate application are listed on next page.

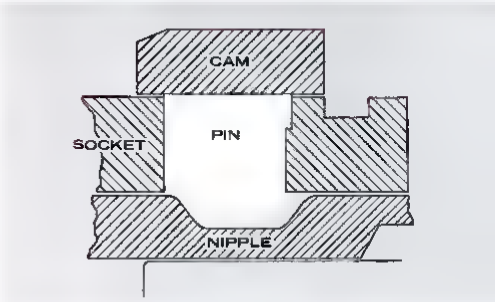
LOCKING PINS KEY TO PRESSURE CAPABILITY, LONG SERVICE LIFE. Locking pins can be seen in the cutaway and the two top illustrations. This design provides a maximum contact of pin, nipple groove, socket body and cam. Net result is an optimum load distribution . . . high-pressure capability. This balanced distribution also virtually eliminates "Brinelling"...prime cause of conventional coupling failure...accounting for ROTO LOCK'S long service life. The mechanical advantage of the cam and chamfered mating surfaces pull the nipple into tight lock.

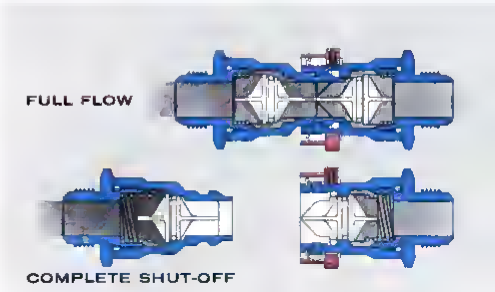
INDICATING MECHANISM GIVES 3-WAY SIGNAL OF COUPLING CONDITION. The indicating mechanism, top right, is a simple, spring-loaded pin. At "open", this pin projects above the cam collar. As collar is rotated to "coupled", pin rides socket body until it finds and seats firmly within flat-bottom hole in nipple body. At this point, coupling is completely locked, pin is flush with collar surface. As the pin seats, a definite click is heard providing a visible and sensory signal of coupled condition.

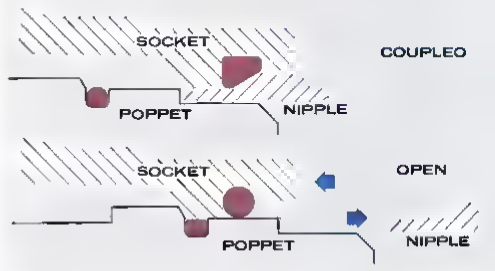
"STAR" POPPETS REDUCE PRESSURE DROP. Cutaway reveals unusual poppet configuration which results in maximum freedom of fluid flow, shown right. ROTO LOCK pressure drop is considerably less than military specifications. In disconnect position, positive self-sealing action is assured by heavy stainless springs and "O" rings recessed in the poppet. ROTO LOCK can be supplied with poppets in both socket and nipple, in socket only, or nipple only.

SIMPLIFIED SEALING HOLDS PRESSURE OR VACUUM. Line drawings, bottom right, show condition of seals during connect and disconnect. This simplified seal construction is so effective that safety or secondary "O" ring or face seals are unnecessary. Note that sloping surface of the nipple body provides an escape-proof location for nipple-socket seal, enabling it to seal with equal effectiveness against very high pressures or vacuums. Note also that the location is remote from damage during connection.









JACK & HEINTZ, Inc.
SYSTEMS FOR AIRCRAFT MISSILES AND GROUND SUPPORT

Development Team

Able Star vehicle is an Advanced Research Projects Agency project under the cognizance of Air Force's Ballistic Missile Division, with systems engineering and technical direction assigned to Space Technology Laboratories and Aerojet-General Corp. designing and building the propulsion system.

Space Technology Laboratories' effort for systems engineering and technical direction of the over-all Able Star vehicle was conducted under the direction of Dr. Adolf K. Thiel, director of Experimental Space Projects; Bertram Abramson, chief project engineer for Able Star, and Thomas Wiggins, project engineer.

Aerojet's Systems Division, directed by Marvin L. Stary, developed and built the Able Star propulsion system as a logical extension of the second-stage vehicle in the Able series of space probes. Propulsion development was initiated in April, 1959, under cognizance of Wayne D. Stinnett, project manager, and B. Holzman, project engineer.

cal systems with the propulsion system.

▪ **Design** concept and analytical and experimental verification of booster interface—a team effort between STL, Aerojet and Douglas.

• **Assembly** of the over-all Able Star vehicle.

Concept of the interstage structure was a departure from the previously used mechanically released rose petal configuration, which involved excessive weight penalties. A rigid cylinder was adopted as the lightest, simplest interstage connection. The interstage structure remains with the Thor booster upon separation of the Able Star vehicle from the Thor. Attached to the inside of the interstage shell are three rails, about 14 in. long, to guide the Able Star vehicle during the initial phases of the separation.

Critical analysis was involved in this phase of the design to ensure that there would be no physical interference with the gimbaling nozzle, since it actually is steering as the Able Star leaves the rails and flies out of the Thor.

Another problem was to avoid creation of forces, before complete separation, which might damage the Able Star vehicle, electrical components in the Thor, such as its autopilot, and the actuator link or gimbal for the Able Star nozzle. Another aspect was to prevent eccentric forces on the nozzle which conceivably could come from excessive exhaust back pressure generated in the interstage compartment and result in loss of reference in the Able Star vehicle. These problems were solved by designing a series of holes in the interstage structure surrounding the nozzle. These holes normally are covered by a blast band which is blown off to uncover the holes just before the staging operation.

Experimental verification of the interstage structure design and staging sequence was accomplished with the Able Star, at Aerojet's Azusa site, in a live firing trial.

▪ **Equipment compartment** which accommodates the avionic components has high accessibility. The equipment shelf is constructed of Fiberglas honeycomb, surrounds the payload (satellite) spin table base and is supported at its inner perimeter by eight struts. These slope radially upward and inward from the propellant tank stub end and primarily serve to support the spin table. To eliminate the cantilever effort on the equipment shelf, its outer perimeter is supported by eight sheet metal ribs attaching to the outer ends of the struts.

▪ **Avionic components.** Designed and built by STL, these units include the autopilot, advanced guidance system (tied in with Burroughs J-1 ground computer), telemetry system, electrical power system, range safety system, accelerometer, programmer and sequencing controls. Within the capability of the basic Able Star stage the programmer will produce different sequence of events, at the appropriate time, with no design modification. Change from one mission trajectory sequencing to another may be accomplished by adjustment in the field.

Sequencing Functions

Sequencing functions control approximately 40 events, such as igniting the Able Star propulsion system, blowing of explosive bolts connecting Thor to Able Star, ejection of nose fairing, initiation of coast control, orientation of Able Star during powered and coast phases, stopping of hydraulic pump during the coast phase, starting of the hydraulic pump prior to Able Star restart, initiation of firing signal for second burning period, and starting of the spin table. Programmer also has the capability of supplying the backup signal for a number of other events, such as actuation of Able Star initial firing if the command signal fails to accomplish this.

The advanced guidance system is said to be about 10 lb. lighter than other guidance systems flown for the type of space probe missions for which the Able Star vehicle has been adapted. It functions in conjunction with the autopilot, reported to be the first to control a coast attitude system successfully.

▪ **Spin table.** Installed in the equipment compartment, the spin table serves as a support for the payload (satellite) under a load condition exceeding 10g. Basically, the spin table

a self contained rotary device including its own battery power supply, timer and sequencing function. Spin is obtained through two radially opposed arms expelling gas fed from the fuel tank pressurization supply. When the gas enters one of the arms, it initiates timing events for spin up and separation of the payload. There is no rotating electrical interface. A clamp secures the payload to the spin table and is released at appropriate time after injection of the vehicle into orbit to allow separation of payload.

• **Nose fairing.** The jettisonable nose fairing is designed to fit a specific payload, so far has been built in two sizes—one to accommodate the Transit 1B payload, and another to accommodate the dual payload in the Navy's Transit 1IA navigation-aid experiment and the larger single payload (satellite) in the Army's Courier delayed-repeater communication experiment.

Nose Fairing Jettisoned

The fairing covers not only the payload but also the equipment shelf and all the associated avionic items. Since the fairing is jettisoned early in the initial burning period of the Able Star vehicle, its weight is absent during the remainder of the trajectory, when the fairing no longer is needed for protection of avionic equipment and payload.

The nose fairing is fitted when the Able Star stage is assembled but it is removed and shipped separately to the launching site for reassembly there on the vehicle.

General flight sequence of the Thor Able Star vehicle involves these basic factors:

• **Thor booster pitch program** begins about 10 sec. after lift-off and continues until just before burn-out, which occurs at about T plus 165 sec.

• **Able Star burning** is initiated about three seconds later, followed by blowing of the explosive bolts, and Able Star flies out of the Thor vehicle. Specific action in Able Star burning begins with a sustained firing signal which energizes two solenoid pilot valves. One causes the helium shutoff valves to open, permitting helium to flow from the storage tanks through a pressure regulator and into the propellant tanks. The other admits pressure-regulated helium to a hydraulic accumulator which in turn opens the oxidizer valve to the thrust chamber. Thus, both propellant tanks are pressurized and oxidizer flow to the thrust chamber is initiated first. When the oxidizer valve approaches the full-open position, it closes a switch to energize a third solenoid pilot valve. This causes the fuel thrust-chamber valve to open, initiating fuel flow to the thrust chamber.

Combustion is initiated by the impingement of the hypergolic propellants, and is sustained at the nominal 206 psia pressure by the constant inflow of propellants from the tanks.

Command shutdown is effectuated by interrupting the firing signal, to de-energize all three pilot valves, closing the propellant valves and the propellant-tank helium shutoff valves.

• **During Able Star** first burning period, it is guided to correct for any dispersions that may have occurred during the Thor flight as well as during the Able Star flight.

• **Nose fairing** is jettisoned at about T plus 225 sec.

• **Cutoff of Able Star** first burning period is accomplished at about T plus 450 sec. by radio command signal from ground station.

• **Coast phase begins** and continues for a period depending upon the orbital conditions to be achieved. In Transit 1B experiment, this coast phase was approximately 20 min.

For Transit 1IA, coast phase was approximately 18 min., while for Courier 1A the coast period schedule calls for 32-min. interval.

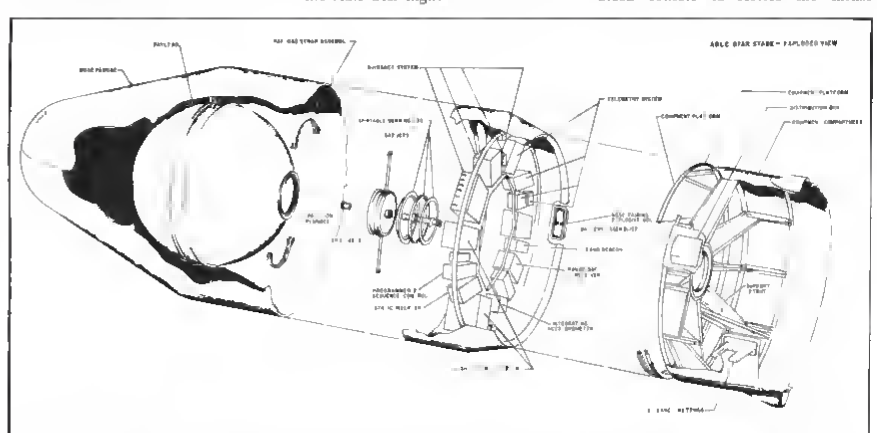
During coast, the attitude of Able Star vehicle is oriented so that upon initiation of second burning period, the velocity increment is tangential to the earth's surface.

• **Able Star restarts,** burns for only a few seconds, and injects the entire vehicle into orbit. (Principal difference between restart and initial start is that the propellant tanks are in a pressurized condition prior to restarting, since they retain their helium after shutdown.)

• **Cutoff of second** burning period is accomplished by use of an accelerometer because the vehicle is so far away from ground command stations, that another method is required for cutoff.

• Payload (satellite) is spun and shortly thereafter it separates from the Able Star vehicle.

In the field servicing operation at Cape Canaveral, Fla., checkout of the propulsion system is performed at a hangar prior to moving the vehicle to the launch site. Checkout equipment consists of a hydraulic fill and bleed console to service the thrust



EXPLODED skeleton view of the forward portion of Able Star vehicle shows struts supporting spin table base which attach to propellant tank (right) outer surface, which also serves as skin of vehicle's center portion

chamber hydraulic gimbal actuation system, a flight sequence control simulator, electrical function test panel, and electrical control simulator. A functional test pressure panel provides the pneumatic pressures required during the functional checkout and system leak check.

The launch control panel used during the integrated systems simulated flight test, is a duplicate of the launch control console panel located in the blockhouse.

All system tests are performed with the propulsion system in a mobile handling trailer.

Test Support Equipment

Test support equipment required for the launch-area operation includes oxidizer and fuel-servicing trailers positioned at ground level instead of at elevated positions in the work stand. Able Star can be serviced with propellants either by manual operation of the trailers in the pad area or by remote operation from the blockhouse. The trailers also can be dumped remotely on command for flow back into the trailer tanks.

The propulsion system can stand in the "ready" position for 30 days without defueling, but a propellant-decontaminant trailer is used to purify and flush the propulsion system if the system is defueled.

All propulsion functions are controlled and monitored from the launch control console in the blockhouse.

The helium pressurization console, located near the launch pad, provides a regulated helium supply for remote pressurization of Able Star from the blockhouse.

Supply and shop vans are used for small shop work and for storage of critical spare parts. An instrumentation van houses recorders for ground monitoring of the propulsion functions prior to liftoff.

Operational Responsibilities

Aerojet's Technical Services Division, under Arnold Gooze, has cognizance over the company's operations to support the Able Star propulsion system in the field, with Lawrence B. Pruett supervising the operation at Cape Canaveral.

STL has the responsibility for the overall checkout of the Able Star prior to launch and maintains a checkout schedule for subsystems including guidance, autopilot, and propulsion systems.

Prior to installation of Able Star on the Thor, STL conducts a flight systems test.

Coordinating STL's field effort at Cape Canaveral are Bernard Bunch and Frank H. Ferguson.

Scientists Discuss Space Power Needs

By Evert Clark

Stockholm—Rapidly growing need for space power systems demands far more basic research and greater selectivity in developing fewer flyable systems, and more help from industry and universities to convert fundamental ideas to hardware, despite the great enthusiasm generated in the past year, the eleventh annual International Astronautical Congress was told recently.

Nathan W. Snyder, scientific adviser of Advanced Research Projects Agency's Project Lorraine (advanced energy conversion research program) and chairman of the power resources and energy conversion panel of Research and Engineering Support Group, indicated that nuclear reactor fuel elements constitute one of the greatest problem areas. Snyder said "we should proceed with the greatest vigor" in reactor development since it is usable in both propulsion and secondary power.

Snyder said he is confident we will see "a great many amazing developments in this field in the next five years." Atomic Energy Commission's Aircraft Reactors Branch "has spearheaded great strides for space application but this work is only beginning what should come," Snyder said.

The immediate problem is to develop electric propulsion systems and learn if they are feasible.

Power Needs

Meanwhile the long leadtime for complete systems demands rapid development of nuclear reactors since it now seems to be the only feasible energy source for high power systems. Examples of power needs include a probable minimum of 100 kw for a three- to five-man moon base, 5 to 15 kw per man for space stations and maneuverable vehicles and 25,000 times more power to telemeter from Mars than from the moon.

Snyder said he believes reactors for 30 to 60 kw systems will be available in five years, reactors for 300 to 1,000 kw may be available in eight to 10 years. Power-producing and energy-conversion system needs vary with the mission so no system now appears to hold a major lead in desirability, although some have a considerable development lead. Snyder sees several more years before the success on long-life ion engines. Several nuclear-turboelectric systems like NASA's SNAP 8 are under development but turbomachinery needs more longevity and reliability.

With regard to other conversion methods, great commercial interest and strong military support promises significant advances in thermoelectric technique in the next year or two.

Thermionics is newer, but great strides have been made in the past two years. Use of a plasma diode reactor fuel element serving as a high temperature cathode could "cause a sharp change in reactor technology if the high temperature fuel element is sufficiently improved," Snyder said.

Efficient conversion of fission fragment energy to electricity by ionization also could "prove to be a major breakthrough," Snyder said.

Power Source Problem

Unsatisfactory reliability of nickel-cadmium batteries used in solar energy satellite power systems to date was not predicted, making the power source problem more severe than expected. Relatively large scale battery improvement research program is being instituted by the end of this year. Batteries are the least reliable part of the power system, yet are half its weight. A year or two of research should change the situation markedly.

Snyder spoke from an ARPA power manual and proceedings of a recent classified solar cell power system symposium which are available through ARPA for those with proper security clearance.

Need for power sources may be closer than predicted if suggestions for accelerating manned exploration programs are adopted. Wernher von Braun, director of NASA's Marshall Space Flight Center, proposed several follow-on Saturn vehicles using orbital refueling techniques and allowing circumlunar flight and manned lunar landings long before larger boosters would be ready.

Refueling also would permit earlier establishment of a space station.

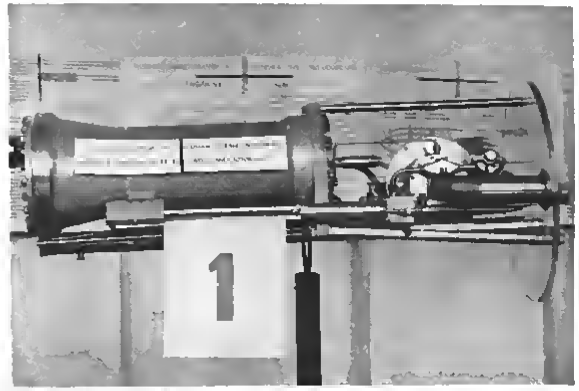
In-Transit Rendezvous

Charles Kaempen of North American Aviation proposed in-transit rendezvous and assembly of individually launched vehicles instead of the orbital rendezvous approach in a detailed study designed to prove feasibility of using fully developed systems like the Mercury capsule and Saturn C-2 for manned lunar exploration well ahead of currently predicted dates.

Von Braun discussed possible development of a special blimp for transporting Saturn stages from Huntsville, Ala. to Cape Canaveral. Other NASA officials told AVIATION WEEK that Sikorsky Aircraft is pushing helicopters for the job and use of C-130, C-133 and C-124 aircraft to carry stages piggyback also is being considered.

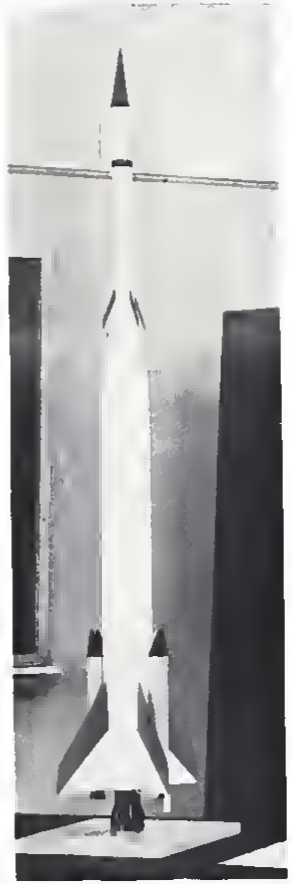
Spaceflight Economics

The economics of spaceflight got considerable attention, with R. P. Haviland of General Electric's Missile and Space Vehicle Division suggesting a world weather forecasting center using a satellite system and based probably in northern Norway. W. F. Hilton and S. R. Dancey of Hawker Siddeley's Astronautics Division proposed an inexpensive commercial com-



FIRST Swedish-built liquid rocket propellant engine, the VR3, was displayed by Svenska Flygmotor. Engine can be used as a booster for manned aircraft, or for missiles or spacecraft. It develops 4,900 lb. thrust at sea level, 5,700 lb. thrust at 60,000 ft. Engine weighs 165 lb.

munications satellite system using several satellites in much closer than 24-hr orbits and boosted by the Blue Streak-Black Knight vehicle. A Douglas Aircraft team, M. W. Hunter, W. E. Matheson and R. F. Trapp, said nuclear rockets properly utilized will give transport capabilities throughout most of the solar system at costs roughly comparable to current air transport costs.

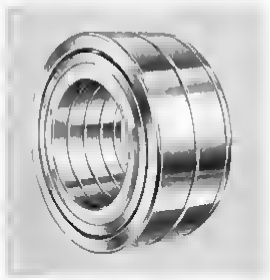


MODEL of the "Aurora HR-1," a proposed high altitude sounding rocket, is shown above. HR-1 would be propelled by a Svenska Flygmotor VR3, originally developed for the Saab Draken before being superseded by afterburner development on the Draken engine. Second stage is solid propellant as are four small booster rockets attached to first stage.

"THUMBNAIL CATALOG" OF FAFNIR BALL BEARINGS FOR DESIGNERS OF JET ENGINES, CONTROLS, AND ACCESSORIES

Jet Engine Bearings

Custom-engineered ta specific load, epeed, temperature, othar raquiremants Typical main rotor bearing shown is fabricated of epecially proc-



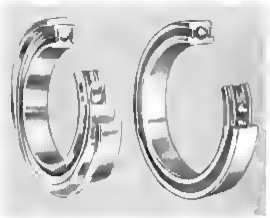
Jet Engina Main Rotar Bearing

essad alloy eteals, the cleanest available. It is an angular contact type bearing with intricate eplit inner ring. All components are precisely fitted. Balls and raceways are precision-finished to millionths of an inch.

Fafnir has produced jet engine bearings in quantity for several years.

Control Bearings

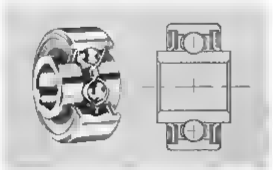
• **Special Precision Series** — The first control bearings made to apecial precieion tolarances to meet the more demanding requirements of high speed aircraft. Boundary dimensions and eccentricities are held to closer precimon tolerances than standard aeries bearings. Bare and autside diameter tolerances are decreased, and radial play ie held to a reduced value.



M-Series Tarque Tube Type Bearings

Fafnir Special Precision Control Bearings pravide increased sensitivity in powerad control systems, and help minimize backlash in the pilot-stick to power boost section of tha system. Bearings in this series are identified by the prefix "M" in the bearing number.

• **High Temperature Bearings** — The first to be developed specifically for control syatems in high Mach. number aircraft Designated tha AW-AK Series, these bearings are counterparts



AW-AK 440C Stainless Steel Bearing

of Fafnir's standard eeries KP-A type, but are fabricated of heat stabilized 440C stainless steel to withstand 500° to 600° F temperatures.

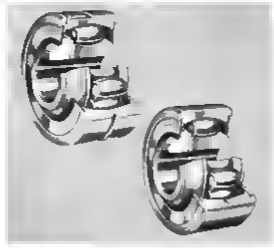
Available with heat-resistant, "law drag" special seals Bearing widths to close tolerances permit ready mounting in standard brackets Especially suitable for application in the critical area forward of the power boost syatem

• **Balanced Design Rad Ends** — Rod ends in this series were the first to be engineered for balanced design. The shank strength, bolt strength, and bearing capacity are kept in balance for more compact, yet rugged construction.

Shank threads are precision-rolled with rounded roots to assure maximum strength and fatigue life. Available with roller bearings for power-operated systems, or ball bearings for manually apereted syetems

Ball and Roller Bearing Rad Ends

• **High Capacity Types** — DSRP and GDSRP bearings offer most capacity for weight and size DSRP bearings have removable seals for lubrication and inspection GDSRP bearings are dimensionally interchangeable but have built-in provision for relubrication. Features include a full complement of precision rollers, large roller-to-race contact, and seals designed to



DSRP, GDSRP High Capacity Bearings

resist damage in case of severe bearing misalignments.

• **Helicopter Bearings** — Typical af Fafnir's helicopter bearings are the Y-PWI Series designed especially for swash plate applications The series consists of matched pairs of thin-section, angular contact type bearings equipped with flexible Plya-Seals. Seals are removable for bearing inspection or relubrication.

Accessory Bearings

More than 10,000 bearing types and sizes in the Fafnir line, including a broad selection of extra-small bearings in inch and metric dimensions, offer answers to a wide variety of accessory

Extra-Small Bearing

equipment requirements Special steels and exotic materials are available for high temperature applications or extremely corrosive conditions. A variety of integral seals, and shields are available for virtually any service conditions Tolerance classes cover all precision requirements

The bearings described here represent only a small selection from Fafnir's extensive line for use in aircraft. Back of them is some 30 years' experience with the industry's requirements — experience that has helped establish Fafnir as a leading supplier of bearings for aircraft engines, controls, and accessories.

For further information about any of the bearings described here or others in the Fafnir line — or for engineering help — contact your Fafnir branch office Or write direct to The Fafnir Bearing Company, New Britain, Conn.

FAFNIR
BALL BEARINGS

CUTAWAY of Douglas S-4 stage for Saturn space vehicle shows arrangement of four 17,500 lb thrust Pratt & Whitney liquid hydrogen engines, and comparison of large hydrogen tank with liquid oxygen tank. Shell is thin stainless steel 120 in in diameter, forming integral wall for the hydrogen tank It probably will be covered with an insulation that can be stripped from around the hydrogen tank just before launch S-4 is a growth version of the Convair built S-5 stage. powered by two Pratt & Whitney hydrogen engines rated at 15,000 lb thrust Douglas stage will form the second stage of early Saturn C-1 vehicles, then will move upward to become third and fourth stages as larger stages are introduced between it and 1.5 million lb thrust booster

The Douglas paper and several others make the point that space is rapidly becoming useful instead of only interesting

Haviland emphasized that a worldwide picture is needed to make national forecasts anyway, so a worldwide center is more practical, benefiting everyone Near-polar location means easy retrieval on every satellite pass.

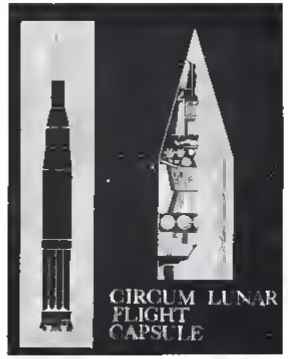
Since existing communication cable links are loaded differently throughout the day, a number or eccentric elliptical orbits with satellites loaded in the same way appears superior to a single 24-hr satellite and could be achieved earlier, Hilton and Dauncey said

Possibility of applying static mag-

netic fields to modify communications blackout effects of plasma surrounding re-entering vehicles was reported by H. Hodara, H. R. Raemer and G. I. Cohn of Hallicrafters Co. They have found transmission windows in plasma below the plasma frequency when longitudinal and transverse constant magnetic fields are impressed in the plasma. Particularly interesting is the discovery of a window at the low end of the spectrum under weak magnetic fields. It has been known previously that windows existed above the plasma resonance frequency.

Special Symposium

Growing number of small sounding rockets warranted a special symposium. The host Swedish Interplanetary Society displayed a model of the proposed HR-3 vehicle based on the Svenska Flygmotor liquid rockets originally developed for the Saab Draken fighter plus other components developed for Swedish military use. The rocket would have several variations using solid upper stages, with the booster recoverable by parachute. Total cost of the largest version would be $32,000. Overall project is named Aurora. The Swedish Space Research Committee is weighing the Aurora proposals against the cost of buying foreign rockets, most likely from the U. S.



SPACE station would weigh 15,000 lb., including 6,000 lb. for the capsule with its instruments and controls. Capsule may have lifting devices for re-entry, plus parachutes for final descent. A "caboose," weighing 4,000 lb. and carrying scientific instruments, cargo, etc., would be attached. The remaining 5,000 lb. is for combination abort and midcourse control system. An orbital tanker to supply propellants to a space station and an orbital cargo carrier to supply cargo have also been proposed. Both vehicles would be preassembled on earth and would be boosted into orbit by the C-2 version of Saturn.

Courier Is Designed For High Reliability

By Philip J. Klass

Washington—Army's Project Courier, an experimental delayed repeater type communications satellite, represents the most sophisticated space payloads produced to date as a result of widespread use of standby elements intended to provide high reliability and long service life.

First attempt to put the 475 lb., 51 in. diameter Courier satellite into a 600 mi. orbit from Atlantic Missile Range, using a Thor-Able Star two stage booster, failed Aug. 18 when the first stage malfunctioned. Another launch attempt is expected in about a month. A second Courier satellite already is on hand at the Atlantic Missile Range and a third payload is now undergoing final test.

The Courier satellite payload designed and produced by Philco Corp. under technical direction of Army Signal Research and Development Laboratories and Advanced Research Projects Agency, provides the equivalent of 16 two-way 100 words-per-minute (wpm.) teletype channels plus one two-way voice channel. Satellite can receive and transmit teletype messages at the rate of 68,000 wpm. In an operational version, four additional teletype channels probably would be substituted for the voice channel.

With this teletype speed and capacity, it would be possible to transmit the entire editorial content of this issue of AVIATION WEEK in approximately 1 min.

Score Version

Project Courier is a sophisticated version of the first repeater communications satellite known as Project Score, which was placed in orbit in December 1958 and which broadcast President Eisenhower's holiday greetings.

In the delayed repeater type, messages are transmitted to the satellite from one ground station and stored on magnetic tape recorders. Subsequently, when the satellite passes over another ground station, it transmits the stored messages to the ground and simultaneously receives new messages from the station which are stored on the tape recorders for the next station in the circuit. The Project Courier satellite also can be operated as an active (real-time) repeater to permit checkout of performance with the received message being rebroadcast by the satellite.

The Courier type satellite is intended for use in handling lower-priority military communications primarily teletype where satellite transit time delay is not objectionable. Because a delayed repeater type satellite need not be viewed simultaneously by both ground stations it can operate at lower altitudes and provide greater privacy than a real-time passive or active repeater communications satellite.

Two ground stations have been established for Project Courier tests: one at Ft. Monmouth, N. J., the other 1,600 mi. away along the south coast of Puerto Rico.

Army's design objective for the Courier satellite payload calls for a 90% probability of obtaining one year service in orbit in subsequent operational models. In an effort to achieve this longevity, Army called for widespread use of standby, or backup, elements in the payload (redundancy), with ability to switch out defective units and switch in replacements from the ground. Although such redundancy adds to complexity, which itself tends to reduce reliability, Army expects a net gain in overall reliability.

Here are a few examples of the redundancy designed into Project Courier payload:

• **Microwave receivers:** Four frequency modulation receivers are installed for simultaneous reception of teletype and/or voice messages transmitted from the ground. Two are connected to one hemispheric coverage antenna, the other two to another antenna that covers the opposite hemisphere. (Satellite is not attitude stabilized.) A video baseband combiner examines each receiver output and combines the signals in proportion to their individual signal-to-noise ratios. Satellite will function satisfactorily, Philco says, despite failure of any one receiver or even two if they are fed by separate antennas. Receivers have 12 db noise figures.

• **Microwave transmitters:** Four transmitters are carried by the satellite, with two of them operating simultaneously on slightly different carrier frequencies to provide signal enhancement through frequency diversity. Other two transmitters are spares which can be individually switched into use upon command from the ground if one of the active transmitters should malfunction. Each transmitter has an output of 5 watts minimum, 8 watts maximum. Frequency modulation is employed with 100 kc. deviation.

• **Beacon transmitters:** Two VHF transmitters, each with 50 milliwatt output, are carried to provide an acquisition signal used by ground antenna to quickly locate the satellite as it comes over the horizon. Beacons operate at frequency of 107.9 mc.

• **Telemetry transmitters:** Dual VHF telemetry transmitters, one for standby, are carried aboard. Each has an output of 1½ watts. These are used to telemeter 35 operating parameters which report on internal conditions and operating status of equipment in the vehicle. Satellite uses FM/FM telemetry techniques.

• **Command receivers:** Dual VHF command receivers, one for standby, are provided to receive command which initially turns on satellite microwave receivers, transmitters and associated equipment when satellite nears ground station. Thereafter ground commands are transmitted via the microwave receivers aboard the satellite.

• **Tape recorders:** Five miniature magnetic tape recorders are carried, four of them for storing digital (teletype) messages, one for analog/voice. In an operational Courier type satellite, each recorder would carry message intended for a different ground station. In experimental model, any one of the four digital data recorders can be switched into use, providing additional redundancy. Courier tape recorders, built by Consolidated Electrodynamics Corp. of California, weigh only 7½ lb. each and provide 5 min. recording time. The four units used for teletype message storage therefore provide total storage capacity for 272,000 words.

The entire payload is transistorized except for the power amplifier tubes used in the four microwave transmitters. Total weight of avionic equipment is about 300 lb.

The satellite's microwave transmitters and receivers are designed to operate in the lower portion of the 1,700 to 2,300 mc. band. The VHF acquisition beacon and telemetry transmitter operate at 108 mc., while the command receiver operates at about 135 mc.

Here is a typical sequence of events that occurs when the satellite comes into view of one of the ground stations, built by International Telephone & Telegraph Corp. Each station is outfitted with a single 28 ft. diameter

PROJECT COURIER delayed-repeater communications satellite can simultaneously receive and transmit stored teletype messages at rate of 68,000 words per minute. Second attempt to orbit the 475 lb., 51 in. satellite is expected in about a month.

antenna, mounted atop a 40 ft. pedestal, built by Radiation, Inc. Single antenna is used to locate and track satellite, as well as to transmit and receive messages and send commands to the satellite.

Antenna would normally be aimed at the expected sector of satellite entry. When a signal from the satellite's VHF acquisition beacon is picked up by the ground station antenna, it transmits a coded VHF command to the satellite, causing it to turn on its microwave receivers and transmitters, its VHF telemetry transmitter, and to shut off the low-power VHF acquisition beacon and command receiver. Satellite officially acknowledges receipt of this command by transmitting back appropriate coded signal over the VHF telemetry transmitter.

When the ground station receives this acknowledgment its antenna goes into search mode, using the carrier from the satellite microwave transmitter to "home" on the satellite. When the satellite is approximately centered in the antenna's beam, it switches over to track mode and automatically follows the satellite until it nears the horizon.

The ground station now is ready to interrogate the satellite and transmits a coded command signal which selects tape recorder for transmission of desired stored message from the satellite. As the stored message is being read out of the recorder and transmitted, the ground station simultaneously transmits a new message which Courier stores on the same tape, or another recorder if desired.

Security Code

To prevent triggering of the satellite by unauthorized persons, each command signal is preceded by a code which is changed each time in accordance with a pre-arranged schedule. Without such precaution, unauthorized stations could cause the satellite to dump its stored messages and discharge its batteries prior to reaching the intended ground station.

Loss of signal from ground station due to fading or other cause, will automatically result in the satellite returning to original acquisition mode, shutting off microwave and telemetry transmitters and turning on the acquisition beacon and command receivers.

Project Courier satellite requires approximately 10 watts of electric power in the acquisition mode to power VHF beacon and command receivers. When the satellite is acquired by a ground station and goes on active status, power consumption jumps to about 225 watts.

Electric power is supplied by 19,152 silicon solar cells, mounted on and covering about 70% of the satellite's spherical surface, which charge nickel-cadmium batteries. The solar cells develop about 70 watts when the satellite is illuminated by the sun. (Less than half the cells are fully illuminated at any time, because of spherical configuration.)

Because the unilluminated cells consume electric power, the 19,152 cells are fabricated in arrays of 84 cells each which are interconnected through isolating diodes that allow current to flow only out of the cells. This also prevents a short or ground in an individual cell or array from adversely affecting the entire solar cell system.

Alternate solar cell arrays around the satellite are interconnected and fed to one of two collector busses, while the remainder of the arrays are connected to the other. Each bus connects to a battery will not discharge the other. Bus voltage is 32 volts when battery is fully charged, 25 volts when battery is at normal discharge level.

Voltage and charging/load current of each battery is telemetered to ground stations. If either battery is not functioning properly, ground station can disconnect its solar cell array and connect it to the other battery so that the payload can continue to operate—but with reduced duty cycle.

Each solar cell is covered with a thin glass protective cover which has been coated with a thin film that filters out infrared portions of solar radiation that produce no electric output and cause unwanted heating of the cell.

The satellite's telemetry transmitter, in addition to reporting on power supply condition, also transmits information on internal and external satellite temperature, transmitter output power level, receiver signal strength and recorder tape positions.

An unusual feature of the 28 ft. antenna used at the two Project Courier ground stations is its multi-purpose, multi-frequency design. Using a single dish, antenna transmits and receives

SINGLE ground station antenna serves both for acquisition/tracking of satellite and for communicating with it at both VHF and UHF frequencies. Antenna uses 28 ft. dish.

messages to and from the satellite at microwave frequencies, receives telemetry signals at VHF frequencies and tracks the satellite at both VHF and microwave frequencies.

Despite the massive size of the antenna it can track at speeds of 15 deg per second, with an error of less than 0.5 deg., according to Radiation Inc. Tracking error is less than 0.25 deg at speeds of 7 deg./sec.

When antenna is trying to acquire the satellite as it comes over the horizon, the 28 ft. dish provides a beam width of 18 deg. and a gain of 19 db. at 108 mc. When it switches over to tracking the satellite's microwave transmitter, the beamwidth is about 1.3 deg. and the gain is approximately 43.5 db.

Phase Source

Antenna employs an electrically rotated phase source to obtain scanning of its beam. Microwave energy from the satellite, focused by the large parabolic dish, passes through an artificially loaded dielectric hemispheric lens spinning at 1,800 rpm before entering the waveguide feed and passing on to the ground receivers. Both frequency diversity and polarization diversity are employed to assure good reception of satellite signals, despite anticipated satellite tumbling. To provide dish illumination in the VHF band a crossed dipole and disk type feed are installed below the microwave feed along the same axis. A four-channel rotary joint is employed to carry microwave and VHF energy to and from end feeds.

Servo system used to position antenna includes provision for coasting at previous rate and direction if satellite signal is lost for short intervals. Control room containing antenna servo system and associated controls is built into the pedestal of the antenna.

Ground Stations

Each of the two ground stations built by International Telephone & Telegraph Corp. for communicating with the Project Courier satellite employs a one kilowatt microwave transmitter and a 100 watt VHF transmitter.

To assure reliable reception of signals from the satellite, despite expected tumbling and selective frequency fading caused by the ionosphere, each ground station employs four microwave receivers in quadruple diversity, frequency diversity and polarization diversity. Additionally low noise parametric amplifiers with 2 db. noise figures are employed. These are dual-channel, lower sideband, up conversion units employing silicon diodes.

The phase-combined signals of each polarization diversity pair are FM detected and combined by equal-amplitude linear limiter combiners, for input

to message recovery equipment. To obtain an antenna tracking signal, the phase-combined signals are AVC detected, providing advantages of diversity to this function as well.

Messages to be transmitted to the satellite, initially prepared on teletype punched tape, are sequentially fed into a high-speed tape reader which reads out each character in parallel form. A magnetic tape machine records the characters in parallel form at slow speed, and the message is then ready for release when the satellite comes in view of the station. During transmission to the satellite, the tape recorder speed is stepped up by a factor of 35:1 so it transmits at the rate of 55,000 bits per second.

Teletype Techniques

Transmission employs "stop-start" teletype techniques, with the transmission being synchronized at the start of each character and the bit clock rate being maintained at 55,000 per second. Messages received are handled in the reverse of the foregoing process.

International Telephone & Telegraph Corp. has designed a number of self-checking features into the ground stations. For example, during intervals when the satellite is not in view, the station can "talk to itself" and thereby check the operation of the microwave message equipment. This is done by a heterodyne oscillator which shifts the frequency of the microwave transmitter slightly so its signal corresponds to the satellite's transmitter and can be received by the ground station's own receivers.

The VHF communication channel also can be checked by transmitting a preprogramed sample tape of telemetry and control signal data, using the frequency translation technique to enable the ground station's VHF receivers to pick up its transmitter.

Final Spin Rockets Fired On Tiros Weather Satellite

Washington—Third and final pair of spinup rockets on Tiros I meteorological satellite have been activated on ground command from Radio Corporation of America's Hightstown, N.J., station.

Tiros ceased transmitting useful weather pictures June 29 after a three-month operating lifetime. During final phases of transmission, the Weather Bureau made actual forecasts based on Tiros cloud cover photographs.

Activation of spin rockets Aug. 18 increased power supply has increased since the end of transmissions. Spin rate went up from 11½ to 13 rpm. Attitude sensors and narrow angle camera are still operating, but useful photos are not possible without wide angle camera pictures for reference.

...AND BRISTOL SIDDELEY SUPPLY THE POWER

Bristol Siddeley Engines supply power for the RAF's round-the-clock defence which shields Britain from possible air attack.

The major part of this defence system is made up of Bristol/Ferranti Bloodhound guided missiles, powered by two Bristol Siddeley Thor ramjets, and Gloster Javelin all-weather weapon carriers, powered by two Bristol Siddeley Sapphire turbojets.

These two types of weapon carrier complement each other and their radii of action form a series of interlocking defensive cones which extend out from the coastline to an effective range of several hundred miles and far up into the stratosphere. No known manned aircraft in service has a performance which would enable it to outclass or evade this round-the-clock defence.

BRISTOL SIDDELEY ENGINES LIMITED

Bristol Aero Industries Limited 200 International Aviation Building Montreal 3 Canada Telephone University 6-5471

Bristol Siddeley Meybach diesel engines power Britain's fastest express train—the British Railways "Bristolian." Two Type MD 650 engines, developing a total of 2,300 hp, give the "Bristolian" a top speed of over 90 mph. Over 200 Maybach diesels have been ordered by British Railways alone.

The Bristol Siddeley Marine Proteus powers the world's fastest naval vessels, the "Brave" class Royal Navy patrol boats, built by Vosper Ltd. Three Proteus deliver a total of 10,500 hp—propel these 86-ft boats at over 50 knots. The Marine Protean is quick starting, flexible and reliable.

The Bristol Siddeley Industrial Proteus powers a 3 megawatt turbo generator. Designed for peak lopping and stand-by generation, this new pocket power station will deliver full power within 2 minutes of a cold start for a lower capital cost than any other type of installation.

THIRTEEN Lockheed C-130s and a Douglas C-124 are on ramp at Wheelus Air Base, Libya during 12-hr. crew rest from Congo airlift.

USAF Overcomes Congo Airlift Problems

By Cecil Brownlow

Evreux, France—Dearth of communications, nagging fuel uncertainties and the necessity of conducting major maintenance in African way stations unheard of only a few days before were the operational problems of the U. S. Air Force airlift effort into the Congo Republic.

Lack of any Air Force communications network that could begin to probe into the interior of Africa at the outset of the airlift of United Nations troops and equipment into the Congo made precise planning of movements an impossibility. Col. Tadeton H. Watkins, commander of the 322nd Air Division headquartered here, who assumed overall operational command of the airlift, termed communications the major deficiency in the whole operation.

"Communications," Watkins says, "were so bad that for about two or three days after an aircraft left Wheelus [AFB, Libya] we had no idea where it was. We had two minors here that we had lost airplanes and it took us about 24 hr. to track each one down to be sure it wasn't true."

Communications Pinch

Lt. Col. R. B. Youngman, Watkins' maintenance chief whose crews ringed Africa in a variety of support missions—including 24 engine changes, eight of which had aircraft on the ground at the same time—also felt the communications pinch.

"We need to get specific when an aircraft is in trouble," Youngman explains. "Once we got the details in here we could dispatch our crews with the proper equipment. When we got the communications problem partially solved, it took care of most of our other problems."

Need for better communications during the initial stages of the airlift also plagued planning at the Leopoldville terminus where aircraft flew in almost unannounced and tower procedures were sometimes hazardous at best. But, to Lt. Col. Francis E. Merritt, commander of the 322nd's 40th Troop Carrier Squadron who headed the USAF contingent in Leopoldville, the search for adequate fuel was "our biggest problem."

Honest Figure

During his two-week stay in Leopoldville through the peak of the airlift, during which Lockheed C-130 turboprop transports of the 322nd and Douglas C-124s of the Military Air Transport Service poured in 9,903 troops from nine nations, plus 4,531,001 lb. of equipment and supplies, Merritt says he "never could get an honest figure on just how much fuel there was available" at Leopoldville.

Merritt and an advance party of 44 maintenance men, load masters and other specialists left Evreux aboard a C-130 in the late evening of July 14, 1 hr. 5 min. after they had been alerted to go. With them was a forklift and some C-130 spares.

The party completed the 3,600 naut. mi. flight to Leopoldville at 5:30 p. m. the following day after refueling at Wheelus and Kano, Nigeria, and a reconnaissance stop at Douala in the Cameroons to see what fuel might be available there for aircraft on return flights from the Congo. (There was fuel at Douala, but it was used sparingly. Proximity of mountains plus intermittent rain and low-hanging fog combined to keep the airport closed for all but approximately two hours per day.)

Joint Control

At the time Leopoldville's Ndjili Airfield was under the joint control of the Belgian military command, whose troops surrounded the area and had secured it from rioting Congolese soldiers only a few days before, and Sabena Belgian World Airlines, whose aircraft were busily shuttling refugees to Brussels (AW Aug. 8, p. 49).

"I had no idea of what the situation would be on the ground," Merritt says.

One of the things he soon learned, however was that Sabena, an old and favored customer already had put in its bid for the major fuel reserves to support its own airlift operation. Merritt was assigned one refueling pit near the terminal building and was left on his own to find fuel to supply it. He did this by approaching the local fuel company representatives and arranging for supplies on an almost day to day basis.

C-130s, accustomed to JP-4 fuel, had to take on JP-1 and, at times, low-octane 100/130 aviation gas. The biggest problem, by far, was to find high-octane 115/145 gas for the piston-engine C-124s. Sufficient quantities of 100/130 were available, but the supply of 115/145, which C-124s must use during takeoff and climb to altitude, remained critical throughout.

Merritt, however, tried to see that each aircraft left Leopoldville for the north with enough fuel aboard to reach its first destination, usually Kano or Accra, Ghana, plus two hour reserve.

The lone refueling pit also caused delays and lengthened turnaround times. To make matters worse, there was no tow truck available, and the pit was jammed near the terminal building in such a way that it was impossible to maneuver an aircraft in the space available. After many attempts at more traditional methods, C-130 and C-124 crews finally found the solution by placing their propellers into reverse pitch and inching backward into the pit, a procedure normally frowned upon for safety reasons.

To try and alleviate the backup which lengthened the flight crews' day as well as to tap other fuel sources, Merritt for the first four days also ordered some aircraft to refuel at nearby Brazzaville across the river in French Equatorial Africa. After four days however the French closed the field to U. S. airlift traffic. Merritt was told only that "they didn't want us over there anymore."

Better Control

Fortunately, the situation at Leopoldville was under better control by this time and the ban at Brazzaville was not as crippling as it might have been earlier.

Merritt says he has "no idea" how many Air Force planes came into Leopoldville during the first two days with cargo and troops, "but there were a lot." He also had little idea of what each aircraft had aboard or even advance warning that it was due to arrive. "So, when we saw a plane landing, we had to start figuring."

Conditions in the Leopoldville tower, according to Merritt, sometimes approached chaos. In normal times, the European controllers had never been called upon to handle anything approaching the clutch of commercial and military aircraft that were now swarming into Leopoldville. They also were alarmed by the political unrest within the Congo and the resultant bitterness toward the Belgians, and some made repeated threats to leave their posts for evacuation upon the next available aircraft.

Tower Monitored

To bar the possibility of an unmanned tower, a four-man team headed by CWO Charles I. Walker from Chateauroux AFB, France, monitored the tower operation on a 24-hr. basis, and Merritt says that, to his knowledge, they were forced to take over the controllers board on at least four occasions to avoid potential midair collisions when two or more aircraft were assigned to the same approach pattern and altitude at the same time.

Merritt's crew at Leopoldville eventually grew to approximately 56 men, all working on a round-the-clock basis off-loading aircraft, refueling them and scheduling them out again. Flight Surgeon Capt. Peter J. Marinakos, who was aboard the first C-130 into the Congo, estimates that Merritt had a total of two hours rest out of the first 72 he spent in Leopoldville. Others were called upon to put in between 36 and 48 hr. between rests.

"I had to give some of them benzedrine to keep them going," Marinakos says. "Others got so hopped up in the excitement of the operation that I had to administer sleeping pills before they could rest."

Before leaving Evreux, Merritt had been told he could expect to be relieved within a few days by a team of 125 MATS personnel from the U. S. Before their arrival however, Soviet propagandists already were complaining of "armed" American soldiers in Leopoldville, and it was decided that it would be politically unwise for more U. S. military personnel to move into the Congo.

"As a matter of fact," Merritt said, "we never left the field, and we tried to keep our people out of the way. Nobody wore arms and no arms were displayed.

"All we were trying to do was offload airplanes."

To add to his other worries, Merritt on July 16 received an urgent request from Sabena officials and the Belgian military to divert an aircraft to fly refugees from Stanleyville 663 naut. mi. away where they said native rioting had become intense. U. S. Embassy officials later confirmed reports that the situation in Stanleyville was critical, adding that Congolese Premier Patrice Lumumba and President Joseph Kasavubu also had lodged a request for an aircraft.

Merritt agreed and with Lumumba and Kasavubu aboard the flight deck, a C-130 flew into Stanleyville, boarded a capacity number of refugees and returned to Leopoldville where the evacuees were routed to other outbound flights.

Urgent Call

The next night, one he terms "the worst of my life," Merritt received an urgent call to supply airlift for 236 Ethiopian troops into Stanleyville to counter a Belgian threat to send its own troops into the area if the United Nations failed to take action.

Earlier in the day, an Army team had installed a single sideband installation at the airfield—it went out completely the next day when the extreme heat within the trailer began to affect some of the instrumentation—and through it Merritt relayed the UN request to Col. Watkins in Evreux at 2 a.m. On this

AIRMEN and civilian maintenance crews flown to Evreux from Warner Robbins AFB, Ga., work together in 322nd Air Division maintenance docks to reduce the backlog of C-130s due for 300 hr. periodic inspections caused by the airlift effort into the Congo.

occasion, the communications link held, and Merritt received acknowledgement of the approval of the Joint Chiefs of Staff in Washington within 30 min after relaying the request.

The troops were finally landed in Stanleyville on the second try after the first had been aborted by ground haze that completely obscured the approaches to the Stanleyville airport.

On July 19, a MATS crew put a single sideband into operation at Leopoldville, and by the 22nd the communications pinch had eased.

Other problems also had begun to work out. UN personnel had taken over control of the Leopoldville tower. Merritt could receive reports of inbound traffic, a weather station was in operation and fuel priorities had been established for the military and commercial aircraft flying into Ndjili.

Before the beginning of the airlift, USAF's line of communications within Africa barely skirted the northern fringes of Europe to Wheelus by single sideband and to the Strategic Air Command base at Sidi Slimane, Morocco and the Nonasseur Air Base near Casablanca by land lines. Air-to-ground communications were lost when an aircraft flew 500 mi. south of Wheelus.

Beyond this the primary source of communications was through the teletype network maintained by the International Civil Aviation Organization. This proved inadequate, according to Capt. Robert F. Williamson of the 322nd Air Division's Transport Control Center, primarily because the native operators "didn't understand our needs, and our pilots didn't understand how to file with them."

The communications void was largely filled by the Air Force's installation of the single sideband unit at Leopoldville and others at Dakar, Senegal, on Africa's western horn, Accra and Kano. A small air-to-ground airways station also was installed at Kano to help fill the gap between Wheelus in the north and Leopoldville in the south.

In another effort to improve communications, the Air Force asked the various embassies to brief ICAO personnel on USAF needs in filing traffic information and saw to it that its own pilots knew about ICAO procedures.

Once the new units were in operation, news of aircraft movements within the Congo often reached Evreux within two-to-three hours as opposed to the two-to-three days of the early operations. There were still gaps however.

A pilot, for example, flying from Goma deep within the Congo where there is only a bare field—no tower, no ICAO representative—must try and get in touch with the airways station in Kano to file his flight plan after takeoff. Barring this—and bad weather conditions, particularly at night, often did—the pilot could only fly on to his destination and hope for better facilities there.

The airlift also hit the 322nd just as it was consolidating its flight-line maintenance in one group under Col. Youngman in conformance with a new Air Force directive, pulling it in from the three squadrons which had traditionally held the responsibility. The Division also was in the process of boosting periods between postflight checks for the C-130 from 40 to 50 hr., the time between periodic major inspections from 200 to 300 hr.

"We were having the usual growing pains," Youngman says, "and when this broke there were doubts over whether the consolidated maintenance would be a workable system. But, if anything was needed to prove the system, this exercise did it."

Advantages of the consolidated system that soon became evident during the airlift included Youngman's ability to cannibalize a part belonging to one squadron to put it in a C-130 of another squadron. "If I had tried to do that when each squadron had its

own maintenance. Youngman said I would have been hit from all sides. Now, it's no sweat.

Many of Youngman's maintenance personnel also were new to Evreux when the airlift began, and the crews worked around the clock for the better part of two days to complete the initial launch of aircraft. Although they had been specifically trained for the C-130, many of their predecessors had arrived after training on other types. Youngman says that when the airlift started with all these new people, I had no idea what would happen. But their ability to really get down and work showed up in the first two days."

When Col. Watkins ordered his C-130s to avoid the flights back to Evreux whenever possible in order to save time and to operate with Wheelus as the northern terminus since most troop lifts were made to the Congo from other countries within Africa, Youngman pulled out his only two postflight check crews and dispatched them to Libya. There, although it was not possible to establish any schedule because of the irregularity of arrivals and departures, the 28 men of the two crews completed 47 postflight checks in less than two weeks.

With each crew working a 12-hr. shift, Youngman says, "we just caught them when they came in and inspected them."

C-130 Maintenance

While there was a MATS maintenance unit capable of handling C-130s already on hand in Wheelus when the airlift began, there were no provisions for handling C-130s, and Youngman had to fix on jigs and equipment as well as crews, including complete engine assemblies, propellers, generators, alternators, starters, wheels and tires. The drain on tires particularly went up as the aircraft began moving into the rough, unintended fields within the interior of the Congo and other areas.

To take care of the operations at Evreux, Youngman fashioned two additional postflight check crews from among the crew chiefs who had been left behind and the remaining line personnel.

At Evreux, a total of 13, 300-hr. maintenance inspections also were made in July, but many of these came before the airlift, and the C-130 models on Youngman's schedule board are clogged together, destined under normal routine to hit the 300-hr. mark in clusters.

To help battle the backlog, 79 civilian technicians were flown to Evreux from the Rome Air Materiel Area, Warner Robbins AFB, Ga., and the August schedule called for more than 20 aircraft to move through the three-day cycle in two maintenance docks.

As a whole, Youngman says the C-130 stood up well under the airlift strain, and "I think we have a hell of a durable plane."

As the two weeks of intensive airlift effort came to an at least temporary end earlier this month, Youngman's crews had the opportunity to make a detailed inspection of several aircraft to "see if we had been overusing them." Thus far, there's been no indication of any excessive wear.

Despite the changes of 24 Allison T56 turboprop engines in such varied places as Leopoldville, Kano, Accra, Lome and Togo, Youngman says the Division "experienced no higher rate of failures than in normal times in relation to the total number of flying hours flown. I can't pinpoint any failure trend other than what might be caused by using different fuels from Leopoldville. We'll have to look at some components, mainly in the hot section, because we've used these fuels since JP-1 retains heat much longer than JP-4, but they actually didn't cause any real problems."

Equipment Scarcity

Because of scarcity of ground handling equipment, changes were sometimes accomplished on a "make do" basis.

Engine change at Lome, for instance, was accomplished with the help of the largest construction crane in Togoland, dredged up after a search by the U S Embassy. Its constructural design, however, prevented the crane from moving into position to mount an engine in the No. 3 slot on the C-130's wing.

Problem finally was solved when the operator moved the crane into a position parallel to the wing, hoisted the engine to the proper level and waited as the aircraft commander, First Lt. Edward D. McHalek, taxied the disabled plane into position, inching it along until the engine was resting securely in its mount.

The aircraft's pressurization system, which is normally a big job to handle," also held up well during the operation although it was operating in temperature and humidity ranges higher than it normally encounters.

Mobile Teams

During most of the airlift Youngman dispatched mobile maintenance teams from Evreux as they were needed, and they touched down in eight different countries in support of the operation. Toward the end, however, he equipped a C-130 as a maintenance support aircraft to clean up the final engine changes and provide any other support needed at the various way stations.

The MATS C-124 Provisional Wing

PERIODIC inspection is begun on the ramp to save time. Sheep in foreground are a traditional part of the scenery at Evreux and seldom stray onto the runways.

operated from Chateauroux Air Base and pulled together with aircraft from five U.S. bases after the airlift was under way met most of its maintenance problems with three mobile maintenance aircraft plus ground crews at Wheelus, Kano, Dakar, Accra and, in the final days, Leopoldville.

For their 200 hr. periodic inspections, however, the aircraft had to return to their home bases within the U.S. This generally restricted an individual aircraft to two round trips to the Congo plus some flying within Europe before it had to return to the U.S.

As an aircraft neared its time of return to home base another would be flown over from the U.S. to replace it and to assure that the Provisional Wing always had a minimum of 51 aircraft on hand.

Although most of the aircraft are approaching the 10-year mark they held up well, according to Wing Commander Col. William Schwartz, and there were no critical maintenance problems.

There were a total of 10 C-124 engine changes during the airlift operation, eight on the older A models which made up about one fourth of the wing's total aircraft. Two of the A model changes were to remove Pratt & Whitney 4360-20W engines that had reached the maximum of 1,000 hr.

Financial Briefs

Loral Electronics Corp. earned $310,537 on sales of $9,084,000 for the first quarter ended June 30, compared with net income of $100,800 on sales of $3,587,000 for the 1959 period. Sales and earnings for the rest of 1960 are expected to be consistent with those of the first quarter, according to Leon Alpert, president of Loral.

Thomas & Betts Co., Elizabeth, N.J., manufacturer of electrical fittings for missile and space applications, reports net earnings of $1,442,000 or 95 cents a share on sales of $11,571,000 for the first six months ended June 30. This compares with earnings of $1,327,000 or 87 cents a share on sales of $10,547,000 for the first half of 1959.

Chance Vought explains the disappointing results of its mobile home subsidiary in the first half of 1960 resulted from expansion by dealers and distributors based on 1959's all time sales high of 149,000 units. "In many cases," the company said, "this expansion was based on optimistic expectations for the future rather than on sound financial capabilities." The steel strike, a severe winter, a general softening of the economy reduced mobile home sales and caused extensive price cutting by dealers who found themselves with abnormally high inventories. Vought has taken steps to offset the decline, among them formation of the Crusader Finance Co. for financing of mobile home sales.

Acquisitions And Mergers

International Telephone & Telegraph Corp. has acquired full interest in the electromagnetic vibration equipment of the L. C. Miller Co., Los Angeles, including key personnel, manufacturing rights, tooling, equipment and inventory. ITT's Industrial Products Division will now make and sell electromagnetic shaker and calibration systems for testing electronic equipments.

Hupp Corp., Cleveland, Ohio, has acquired for cash all outstanding stock of E. Roy Industries, Ltd., Montreal, Canada, and will operate the acquisition as a subsidiary. The Canadian company has a division which makes parts and assemblies for aircraft at L'Assomption, Quebec.

NASA International Projects Move Ahead

By Edward H. Kolcum

Washington—National Aeronautics and Space Administration is moving ahead with its cooperative program for international space launches and has begun construction of its eight overseas Mercury tracking stations in spite of pressures against U S bases on foreign soil

NASA contends that neither its identification with the U-2 incident nor subsequent diplomatic and popular agitation against U S overseas military bases has undermined its ambitious international space program, which includes construction of the vital Mercury tracking stations

Threatened repercussions stemming from a massive Soviet propaganda effort against U S overseas bases have not materialized, apparently because of continued U S assurances that Mercury stations will not be used for military projects

Nationalist demonstrations contributed to abandonment by the Army of plans to locate a Courier satellite tracking station in Zanzibar, but a Mercury tracking installation is under construction there even though no formal agreement for the site exists.

Planned demonstration of 100,000 native marchers against Mercury site in Zanzibar July 12 resulted in token protest by 2,000 natives Agitation against the Mexican Mercury site immediately after the U-2 crash apparently was confined to legislative remarks, causing no delay in construction.

Construction is under way at all eight overseas Mercury sites, with formal agreements pending for those located in Zanzibar, Nigeria, Bermuda and Canton Island Nigeria becomes a sovereign nation Oct 1. The British Foreign Office conducts diplomatic negotiations for the other bases Agreements are completed for two sites in Australia, one in the Canary Islands and one in Mexico

Arnold W Frutkin, director of NASA's Office of International Programs and the agency's main contact with the State Department, said the distinction is made clear in diplomatic negotiations that the Defense Department participates in NASA programs only to provide support not available elsewhere—not for military purposes.

Frutkin said the U-2 incident and its repercussions have not had a single substantive impact on tracking negotiations, that the long period required to formalize the remaining agreements results from diplomatic processes He said NASA expects negotiations to be concluded in much less time than the three years normally taken to write bilateral agreements.

In addition to the Mercury network, Frutkin said, U S. is proceeding with an unhampered international cooperative program highlighted by these projects:

- **Firm joint launching programs** with Italy, Canada and Great Britain.
- **Preliminary discussions** with approximately 10 other nations on cooperative space research ventures
- **Establishment of deep space tracking** net with 85-ft steerable dishes in Australia and South Africa, and lateral extension of the Minitrack net with two stations in the Northern Hemisphere
- **Employment of foreign technicians** in the operation of overseas tracking stations Five of nine overseas Baker-Nunn camera sites are operated either exclusively by nationals of the country involved or jointly with the U S. All six overseas Minitrack stations are operated jointly or by the countries where they are located, and approximately half of the Mercury stations outside the U S will be joint operations
- **Senior scientist exchange program**, which so far has resulted in assignment of six foreign scientists to NASA operations
- **Exchange of information** on experiments, before launch and after.

First Joint Firing

First joint launch program is scheduled for next month in Sardinia during International Rocket Week when Italian scientists plan to fire several sodium flares as payloads of Nike Asp launch vehicles Italy purchased the launch vehicles provides tracking cameras and will reduce data NASA will furnish the sodium vapor payload and will assist as consultant

The experiments, studies of wind activity and shear in the upper atmosphere, follow similar launches by NASA at Wallops Station, Va.

Canadian and British joint experiments are scheduled for next year, using the four-stage Scout as launch vehicle. The Canadian project involves a topside sounder satellite and will be launched from the Pacific Missile Range The British program calls for three satellites, which probably will be launched from Wallops.

Canadian sweep frequency topside sounder will be designed to study the ionosphere from above, supplementing data on the bottom side of the ionosphere which can be obtained from ground radio stations. Canada is particularly interested in auroral zone sounding to solve communication problems in polar and Arctic regions

Joint effort calls for Canada to provide the satellite and tracking net in Canada, and U S to test prototype instrumentation in a sounding rocket launch, as well as to provide vehicles and launching services for various satellites

Joint British program (AW Feb 1, p 23) has been discussed in a working group meeting in this country Second meeting will be held next month in Britain

Proposals Received

Formal or informal proposals have been received from Australia Belgium France Japan Sweden, Argentina Israel, New Zealand Spain and West Germany in addition to the previous firm programs with Italy, Canada and Britain

Proposals range from exchange of scientific personnel to sounding rocket and satellite payload instrumentation details

In the field of personnel exchanges, NASA next month will receive the seventh foreign senior scientist under a research associateship program of the National Academy of Sciences Senior scientists accepted under the program come from Australia Japan India, New Zealand and Denmark, and they are assigned to the Theoretical Division of Goddard Space Flight Center

NASA is now considering a program for foreign junior scientists who would be trained at the NASA laboratories while they remain on the payroll of their sponsoring country or agency

Exchange of scientific information, principally concerning space vehicle launches has been made routine so that foreign scientists can prepare equipment for possible ground based experiments Frutkin said World communications net (AGIWARN) established during the International Geophysical Year is used to provide information on experiments orbital characteristics payload weights transmitting frequencies and power output to scientists throughout the world. World Data Centers and scientific journals publish and distribute results of experiments, Frutkin said

Laboratory Space Test Capsule for WADD

General configuration of a laboratory space test capsule, designed for Wright Air Development Division by AiResearch Mfg Co (AW Aug. 15, p 31), is shown in artist's conception. Unit will be used for study of space flight stresses and for evaluation of space life support systems. Cabin is 8 ft. long and 6 ft. in diameter.

Soviets Accept U. S. Offer

Washington—Soviet Union has formally accepted the U.S. offer of its worldwide tracking network for use in the Soviet manned satellite program. Since the acceptance was received before the summit conference collapse, its current validity is unknown.

Offer of the tracking network was made late last year (AW Dec. 14, p. 28) by National Aeronautics and Space Administration Administrator T. Keith Glennan through the National Academy of Sciences to the USSR Academy of Sciences. Visiting Soviet scientists informally agreed then that a general study on cooperative activities is desirable.

Formal USSR reply was received Mar 16 by the U. S. National Academy, but this fact was never made public. The brief note said the Soviet gratefully accepts the U.S. offer and would use the tracking network, if it needs to. It was signed by Y. K. Fedorov, corresponding member of the USSR Academy.

Collapse of the summit meeting in mid-May and the subsequent continuing strained relations between the two countries now makes the Soviet acceptance questionable

Trudeau Takes Direct Control of Army R&D

Washington—Army has assigned direct operational control of research and development functions to Lt Gen Arthur G Trudeau chief of research and development

Gen Trudeau was given complete control of research and development functions of the technical services—chemical, engineer, ordnance quartermaster, signal and transportation Previously, control was channeled through the deputy chief of staff for logistics from Trudeau to technical services chiefs

Soviets Boost Foreign Aircraft Sales Effort

Moscow—Soviets appear to be stepping up their efforts to sell commercial aircraft outside the Communist bloc. Avtoexport reports it has already sold an Il-18 turboprop transport to Ghana. The Soviet trading organization put on an aircraft demonstration here for representatives of 23 foreign embassies in Moscow, including the U. S., England, Greece, Argentina, Japan and various Communist and non-Communist countries.

Guests took a demonstration ride in the Il-18 and watched the flight of an Mi-4 helicopter at Vnukmo Airport. Avtoexport Chairman D. M. Kutyrtov was quoted by Ekonomicheskaya Gazeta as saying "with some countries initial agreements already have been concluded for sale of the Il-18 and the last one of such agreements was signed recently with Ghana. In selling aircraft, Avtoexport also provides the necessary equipment and spare parts supply. Besides by desire of buyers Soviet specialists are sent to teach local staffs and to give technical aid in operation. Specialists also are accepted for training in the USSR."

Ghana was the only customer specifically mentioned but it was noted that the Mi-4 had been sold to 17 countries—Austria, Iraq, Indonesia and Afghanistan plus Communist countries.

Foreign trade journal Vneshnyaya Torgovlya has carried English language advertisements for Il-18 and Ka-18 sales.

Folland Aircraft Will Market Hovertrucks

London—Folland Aircraft—now a member of the Hawker-Siddeley Group—will follow up its design studies of ground effect vehicles by marketing a series of Hovertrucks.

First Hovertruck will carry a five ton payload and the company says it will be a "robust commercial vehicle."

Propulsion and control systems have not been described, but they are claimed to give a considerably greater degree of maneuverability, both in hovering and at cruise, than has so far been achieved by any other ground effect vehicle. The basic theory reportedly follows closely the Cockerill Hovercraft project.

A demonstration model called GERM (ground effect research machine) is under construction, slated for operation in the near future. While basically a model of the Hovertruck, it will be capable of being modified without any major structural changes to incorporate representative designs, recirculation systems, and more advanced forms of control.

OVERHEAD view of the Northrop T-38 trainer shows area rule pinch on inlets. Mild buffet is caused by flow disturbance between exhaust nozzles and will be eliminated by a saddle fairing. Dots forward of pilot's windshield are two of four pitot static ports.

Aviation Week Pilot Report:

T-38 Trainer Has Fighter Performance

By William S. Reed

Palmdale, Calif.—Safety and good handling qualities combined with performance characteristics of some of the later Century series fighters were demonstrated during an AVIATION WEEK flight evaluation of Northrop Corp.'s T-38 Talon supersonic trainer version of the N-156F fighter.

The Talon should fit well into the USAF Air Training Command role for which it was designed by providing student pilots a multi-mission training capability including supersonic flight to better than Mach 1.2, range of 1,000 naut. mi., mission endurance time of better than 2 hr. and an altitude capability of 57,000 ft.

During a recent flight in the Talon from the Norair Division facility at Palmdale Airport, Calif., this AVIATION WEEK pilot noted the aircraft's stability and handling qualities in both the supersonic and low-speed flight regimes, the rapid acceleration to climb speed and the high rate of climb and the ease with which the new trainer shipped from subsonic to supersonic flight without apparent trim change.

Aircraft used for this flight was No. 10 off the Northrop production line, bearing USAF serial number 91597. The Talon was equipped with General Electric YJ85-5 engines with variable nozzle afterburners. Thrust output of the YJ engines is 3,600 lb. with afterburner; the production engines will put out 3,850 lb. thrust.

The T-38 was designed and built by Northrop to meet Training Command requirements for a two-place supersonic trainer in which pilot trainees will be given the latter half of basic course, in flying training. The aircraft features tandem seats with the instructor's seat raised several inches higher than the student's seat in front, providing exceptional visibility even during taxiing.

It has a hydraulically actuated, tricycle landing gear with steerable nose wheel and a full-powered, irreversible hydraulic control system with artificial feel system.

All controls are duplicated in both cockpits with the exception of ground starting switches, fuel boost and cross feed switches, rudder trim switch and stability augmentation switches. Amber monitoring lights which glow when the boost pump switches or the crossfeed is turned on allow the instructor in the rear seat to monitor the student's fuel handling procedures.

Northrop experimental test pilot Don Papish conducted the walkaround inspection, which requires the usual inspection for condition of wheels and tires, general airframe condition and cleanliness of intake ducts and exhaust nozzles. The aircraft is entered either by the use of externally hung ladders or with the aid of an internally concealed ladder and step. Individual clamshell type canopies are provided, as are electrically adjustable ejection seats.

Starting sequence, conducted by Papish from the front seat, is simple. External compressor is brought up to speed for air and electrical power. Start switch on the right engine is placed in the "ground" position and held until 10% rpm is reached. Right throttle then is brought into the "idle" position and the engine allowed to accelerate to idle speed, about 47%.

After a stabilized idle rpm is reached, the right engine is boosted to 85% or above to provide crossbleed air for starting the left engine. Starting sequence used is identical to that of the right engine. Left engine also can be started with the ground unit.

T-38 Dimensions

Length	43 ft. 1 in.
Height	12 ft. 11 in.
Tread	10 ft. 9 in.
Wing	
Area	170 sq. ft.
Span	25 ft. 3 in.
Sweep	24 deg.
Incidence	0 deg.
Dihedral	0 deg.

Pre-Taxi Checks

Pre-taxi checks consist of assuring that both the left and right engine-driven generators are on the line (warning light out) and that the utility and flight control hydraulic systems are at full 3,000 psi operating pressure. Utility system, driven by the left engine hydraulic pump, supplies pressure for primary flight control system, speed brake, landing gear and nose wheel steering and the stability augmentation system. Right engine system supplies power only for the flight control system, thereby providing for flight control through either engine since dual actuators are provided for on each surface. Wing flaps are electrically actuated by 115-v.a.c. power. Power of 70-75% is needed on both engines to overcome static friction and commence the aircraft rolling from the parking area. Once forward motion is attained, idle power provides sufficient thrust to keep up a nominal taxi speed.

Steering on the ground is accomplished through the nose wheel with hydraulic steering actuated by holding down a button near the base of the control stick. A holding relay, which permits nose wheel steering to remain engaged with one push on the button and disengaged when the button is again pushed, is not incorporated in this aircraft but will be included in future production models. An advantage of the relay is that the right hand remains free during taxiing for a variety of tasks such as radio tuning, trim recheck, warning light test, etc.

Canopies are actuated by a mechanical lever on the right side of each cockpit which moves up and forward to close and lock. No power, other than muscle, is provided through a mechanical advantage. Perhaps due to stiffness in the system, to [illegible] counterbalance or lack of muscle power, the canopy on the aircraft could not be closed with one hand. It was necessary to allow the aircraft to roll forward and then apply brakes to overcome the balance on the canopy and provide extra momentum to start the hatch closing.

Takeoff Technique

Takeoff technique used in the T-38 is similar to that used in most present-day fighter aircraft. Full military power is applied to both engines with brakes held after the aircraft is lined up with the runway centerline. Nose wheel steering is engaged, the brakes released and the throttles shoved forward past a friction detent into afterburner range. Establishing firm nosewheel steering prior to afterburner lightoff assures directional control should one engine fail to light.

On this flight, nearly all flying including takeoff, climb, cruise, moderate aerobatics, descent and landing was done from the back seat with an occasional assist from Papish in the front.

Afterburner lightoff is "soft" in the T-38 because of the segmented burner

FIRST T-38s off production line at Northrop's Hawthorne, Calif., plant carried extensive instrumentation in the rear cockpit.

T-38 TRAINER used for Aviation Week pilot report was off the ground in about 3,500 ft., despite a runway temperature of 115F and a field elevation of 2,500 ft.

control in the J85 engines. There is no loss of thrust followed by a "kick in the pants" as is experienced with two-position nozzle afterburners.

Rudder control becomes effective at approximately 70 kt. whereupon nose-wheel steering is disengaged. Nominal back pressure of about 35 lb. on the stick starting at 130-140 kt. will lift the nose wheel about 2 ft. off the runway where it is held until the aircraft flies itself off the runway at about 160-165 kt. Flaps are retracted as airspeed builds up but the nose is held high enough to prevent the airspeed from exceeding 220 kt. until the flaps retract fully.

A slight lateral instability is experienced shortly after breaking ground but this is not disturbing. Possible cause of this is uneven airflow at the time of leaving ground effect or a "nibbling" at the controls caused by depletion of the utility hydraulic system when the gear is raised.

Once the aircraft is cleaned up, acceleration to the best afterburner climb speed of Mach .92 occurs rapidly. Standard day performance calls for one minute from takeoff to reach best climb speed of Mach .92 (608 kt. at sea level) but the aircraft is "q" limited to 550 kt. inasmuch as the Palmdale runway temperature was 115F and field elevation 2,500 ft.; acceleration was somewhat slower with the derated YJ engines.

Climb speed of Mach .92 at an indicated airspeed of 550 kt. was reached at about 6,500 ft. MSL at which point the climb schedule was met. Over the nose visibility, even from the rear cockpit was very good during the high angle climb. Exactly what rate of climb was

T-38 Talon Performance Summary

Takeoff Weight	11,550 lb.
Takeoff Ground Run	2,700 ft.
Sea Level Rate of Climb	28,500 fpm.
Design Weight	9,000 lb.
Maximum Speed	Mach 1.24
Absolute Ceiling	57,000 ft.
Landing Weight	8,500 lb.
Landing Ground Roll	3,000 ft.
Single Engine Performance Summary	
Rate of Climb	6,800 fpm.
(Takeoff weight, max. power, gear up, flaps up, sea level)	
Rate of Climb	800 fpm.
(Takeoff weight, max. power, gear down, flaps down, sea level)	
Maximum Speed	Mach .96
Service Ceiling (100 fpm.)	45,000 ft.
T-38 Mission Summary	
Navigation Training Mission	
Total mission time (20 min. sea level loiter)	2.5 hr.
Range	1,040 naut. mi.
Maximum Endurance Mission	
Total mission time (20 min. sea level loiter)	2.75 hr.
Supersonic Training Mission	
Total mission time (incl. 10 min. in excess of Mach 1 20 min. loiter at sea level)	1 hr.

attained at 5,000 ft is not known since the R/C indicator was pegged at +6,000 fpm, but the book says sea level rate of climb is 28,500 fpm. However, 40,000 ft MSL was reached in about 3 min. Although a complete evaluation of performance has not been published due to a lack of data with the production engines, Northrop says the T-38 will hit 40,000 ft from sea level in 2¼ min. This compares favorably with the 3 min required with the YJ power plants.

Climb was continued on toward 45,000 ft., but at 42,000 ft. the afterburner on the right engine went out. This occurrence was not unanticipated since final nozzle setting and fuel control trim had not been worked out for this engine. It was interesting to note that very little yaw occurred with one engine in afterburner and the other in military power.

Stall Buffet

Mach .92 was held at 45,000 ft. while the aircraft was put through a series of turns bordering on the stall buffet. Despite the paucity of wing area, the T-38 behaved very well in a 30 deg. bank. Cruise conditions at 45,000 ft. were at Mach .92 indicating 250 kt., and fuel flow at 700 pph per engine. Fuel remaining after the afterburner climb to altitude was 1,300 lb. per tank (2600 lb. total), enough for a good 1 hr. 20 min. cruise with reserves. True airspeed works out to about 515 kt. or nearly 600 mph. Had maximum range been the objective of this mission, climb would have been made in military power following a schedule of Mach .75. The same amount of fuel would have been used in such a climb to altitude, but the distance traversed would have been greater. A 1,000 nautical mile range under VFR conditions is not unreasonable for cross country flying.

Descent was made to 35,000 ft. where both afterburners were lit for a supersonic dash. The Talon slid easily through Mach 1 without the usual nosedown pitching moment experienced in many aircraft in the transonic region. Neither was the characteristic Mach jump associated with attaining supersonic speed present. Papish said that a jump does occur in the pitot static system on test aircraft equipped with a boom-mounted airspeed indicator, but that location of the static ports on the production aircraft, four of which are arranged cruciform fashion forward of the windshield, eliminate this phenomena. With about 2,000 lb. of fuel remaining at this time, the Talon stabilized at Mach 1.2 at 35,000 ft. indicating 430 kt. for a true airspeed of 640 kt. (725 mph.)

A steep turn was then initiated, power reduced and the aircraft allowed to fall back subsonic. When 220 kt. IAS was reached at about 30,000 ft. the gear was lowered and flaps extended in preparation for a power-off stall. A 90 deg. left turn was made at 170 kt. and air speed reduced to about 155 to simulate final approach speed. Landing attitude was established as the aircraft achieved a mild stall at about 130 kt. at this altitude. Aileron control was good up to the last and the nose fell straight through the horizon. At no time was there any evidence of pitchup at the stall.

The aircraft then was cleaned up, cruise power added and a 300 kt. speed established. At this point, it was discovered that the pitch damper had inadvertently been left in the off position and had not been missed. Not even through a series of aileron rolls conducted from the back seat had the absence of the pitch damper been noted, nor was it missed during the transition from subsonic to supersonic flight. The yaw damper, used throughout the flight, has a more noticeable effect on the aircraft's stability but neither is essential for flight.

Descent back to Palmdale was made at 300 kt. with power in idle to simulate weather penetration conditions. During descent, it was noted that a high frequency buffet of the nuisance category, although noticeable throughout most of the flight, was more prevalent. Papish eliminated the buffet by cracking the speed brake slightly. Nature of the buffet is a flow disturbance in the area above the exhaust nozzles. A saddle fairing has been tested which eliminates the buffet and will be fitted to all production aircraft.

Traffic pattern was entered at 350 kt. IAS at an altitude of 1,000 ft. above terrain. Approximately 300 lb. of fuel remained in each of the respective left and right fuel tank complexes, making for a gross weight of about 8,300 lb. After pitch out to the left, the speed brake was deployed and throttles retarded. When the air speed dropped to 220 kt., the landing gear was lowered, the speed brake retracted and the flaps started down. By the time the aircraft was on base leg, the airspeed was down to about 170 kt. so the throttles were brought back up to 75% rpm. Final turn was made at 170 kt. Airspeed was allowed to bleed off to 155 kt. over the fence.

Touchdown occurred at 135 to 130 kt. The T-38, like present-day Century series fighters, is a high sink rate aircraft and power must be used through a normal landing approach. In this respect, it will make an ideal trainer since it will provide students with an aircraft in which to develop the technique to be used in fighter aircraft.

If a minimum distance landing is necessary, the speed brake can be deployed and the right engine cut as soon as all three wheels are on the ground. Eliminating the residual thrust of one engine materially aids in shortening the landing roll.

Single engine operation in the trainer poses no serious threat since there is ample power available. Minimum single engine control speed is 150 kt. in the landing configuration. Sufficient hydraulic power still will be available for flight control operation, even though one engine is shut down, since each control surface is actuated by tandem actuators supplied by separate left and right systems.

Flight test data show that the single engine rate of climb at sea level at takeoff weight is 6,800 fpm. in the clean configuration. Single engine climb with gear and flaps down is 800 fpm. Slightly higher airspeeds are recommended in the landing pattern during single engine approaches to assure that minimum control speed will not be encountered should a go around be necessary.

Most critical engine to lose is the left one since the pump on the left engine powers the utility hydraulic system. However the landing gear will free-fall to the locked position (the nose gear retracts forward so air loads will facilitate its locking). Speed brake will be inoperative as will the stability augmentation system, but neither of these are essential to safe flight or landing.

Should fuel imbalance occur, fuel can be transferred from one tank to another by turning crossfeed on and turning boost pump off on the low side. Both engines can be run from one tank and similarly, both tanks can feed only one engine. Left engine fuel supply is contained in both dorsal and the forward tanks while right engine fuel supply is carried in the center and aft cells. Left system contains 286 gal. (1,860 lb.); right system 294 gal. (1,911 lb.). Total fuel supply is 580 gal. (3,771 lb.).

The T-38's performance results from a combination of light weight and high thrust. Total airframe weight is 3,391 lb., probably due in great part to the fact that the Talon is not as highly stressed as combat fighter designs. With maximum gross weight at 11,650 lb., the g limit is +4.9 and −2.0. At the design weight of 9,000 lb., g limits are +5.9 and −2.4. Usual criteria for fighter aircraft is 7.33g.

Ailerons and rudder are restricted in movement by a limiter device which becomes engaged when the landing gear is retracted. Maximum aileron throw with gear down is ±60 deg. and rudder is ±30 deg. When the gear retracts

however, the limiter engages and restricts aileron movement to ±32.5 deg and rudder to ±6 deg.

Also incorporated to aid in coordinated control movement at high indicated airspeed is a 'q' actuated aileron-rudder interlock. At an indicated airspeed of 370 kt. the interlock comes into play, coordinating rudder movement with right aileron actuator movement.

The aircraft now is moving into Category II testing at Edwards AFB where Air Force Flight Test Center pilots and ATC instructors are determining the serviceability of the machine and testing computed mission profiles. Additional tests still are being run to determine performance curves with the production J engines as improved over the YJ engines. One recent test was run by Papish to determine whether or not the aircraft should be subjected to 'pushovers' with the fuel supply below 300 lb. for each engine. Northrop engineers believed that even though the aircraft has an inverted flight fuel supply cell the engines might flame out due to fuel pump cavitation with tankage down that low. The engineers were right and the engines did. The result was the first double flameout landing when the igniters on both engines became flooded and a relight was impossible.

Recommended procedure in this case is to abandon the aircraft but the 15,000 ft. runway at Edwards looked inviting. Most interesting aspect of this incident is that sufficient hydraulic pressure was available from both engines windmilling at 10.15% to provide ample flight control. It was even possible to hold the nose wheel off when the aircraft touched down, indicating ample hydraulic pressure for stabilator movement.

Northrop reports that the total commitment from the Air Force is for 213 aircraft under either firm order or active negotiation. Over-all Training Command requirement predicated on a pilot training program of 1,500 pilots per year is for 740 aircraft but whether or not funds for this number will be forthcoming depends on pilots trained per year and on fiscal availability.

First contingent of T-38s will go to the ATC Instructors School at Randolph AFB, Tex., in March 1961. Final Category III test program will be conducted at Randolph where the final curriculum also will be worked out.

The first group of 25 students out of the class of 62-F will begin basic flying training in the trainer in September, 1961. Thereafter, student training in the aircraft will begin at Webb AFB and Reese AFB, Tex.; Vance AFB, Okla.; Williams AFB, Ariz., Craig AFB, Ala., and Moody AFB, Ga.

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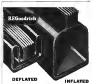

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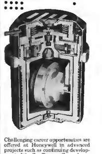

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LETTERS

Swing Tail Amphibian

The Industry Observer section of your July 18 issue reports that Air-Craft Marine Engineering has proposed to Army an amphibian cargo airplane that could accept cargo at sea. It would have a swing tail hinged at the top. A range of 3,000-3,200 mi would allow it to carry cargo from a freighter at sea to a point some 1,500 mi inland.

Having a number of years of seaplane experience in the Navy, including six years of flight testing, I doubt the feasibility of this concept. Without going into detail, but remembering the service-at-sea concept of the P6M, I suggest that Air Craft Marine Engineering contact The Martin Co. for verification of my doubts.

There are too many pitfalls in the above concept, a few of which are:

1. Excessive relative motion between the ship and airplane during cargo transfer operations.

2. Limiting sea state in which the airplane could operate safely—approximately 5 ft. maximum wave heights for continuous operation.

3. An amphibian is inherently poor when operated as a seaplane because of the excess weight it takes on when the wheel wells fill with water.

4. The carry-through structure for a swing tail could possibly be excessive if designed to accept impact loads frequently received in seaplane operations.

5. Possible prohibitive cargo tie-down and deck strength requirements.

CDR. T. E. MADSEN, USN Ret.
Palo Alto, Calif.

SAC Copilot

I have been very interested in a recent series of letters in your magazine concerning unhappy pilots. I can't feel very sorry for Mr. Power Waters (May 9, p. 134) since the airline pilots generally get much more money for less work than we do in SAC, and they can quit at any time as well.

I strongly agree with Lt. McDaniel (July 4, p. 102) who is leaving the service for I too, was trained in F-100s and sent to SAC. I was sorry to see that Lt. Boehler (July 18, p. 154) was so upset, particularly since he almost got out too. At least he is still in TAC which is not as bogged down in paper work and red tape as SAC.

Then Lt. Col. Callam (Aug. 1, p. 102) wondered about Lt. McDaniel's orientation to SAC. Quite possibly it was like mine, in which I went through B-52 ground school, reported to Westover AFB in August, met my squadron commander in November, was put on a crew and started upgrading in December, was finally combat ready in May and shipped out to another base a week later. In all this time, indoctrination was just about nil. Admittedly the job of SAC is important, but most people will agree that it is disappointing to suffer the boredom of a copilot with routine duties after flying the F-100. I can't help but think that my college degree, regular commission and two years of training are being wasted on a job which could be done by any normally bright high school boy after about two months. As for promotions, what commander would give a crew to a young lieutenant when we have so many command pilots serving as copilots?

Finally, both Lt. Boehler and Col. Callam mention that we are officers first and pilots second. This is a nice thought and would help a lot if it were true. Unfortunately there is no opportunity for a SAC copilot to exercise leadership, command responsibility, initiative, etc., which are usually associated with officer rank. In my two years with SAC I have generally found that rank below that of Lt. Colonel means very little except for pay, an occasional "sir" and a rather rare salute. Those who stay in to defend us all have my thanks and respect, but I will be very glad to be a civilian in a few weeks.

ROBERT O. BOARDMAN
1/Lt., USAF
336th Bomb Squadron
Turner AFB, Ga.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Shock Tests

On p. 90 of your July 25 issue in the paragraph subheaded "Modified for Submarines" the following statement appears:

"Following NEL recommendations Nortronics has required electronic components and modules to withstand 25g shock loads."

The above recommendation did not come from NEL. The acceleration each component sees during high impact shock is directly related to its natural frequency. At this time no satisfactory shock spectrum curve is available. Equipment designed for as low as 25g seldom passes the high impact shock tests. In lieu of having a shock spectrum, we design primary structures for 100g and secondary structures for 50g. Although these figures should not be considered a substitute for a shock spectra, equipments designed to these accelerations usually survive the Navy high-impact shock tests.

It has been our experience that designers of shipboard equipment are continually looking for a single acceleration value which can be used for design purposes. To quote a figure as low as 25g can only lead them to trouble. We would appreciate a correction.

H. K. HAUSER
Supv., Mechanical Engineer
Navy Electronics Laboratory
San Diego, Calif.

Report Titles

I frequently have occasion to use AVIATION WEEK in my research on government procurement and have a suggestion to make which I think might be helpful to your readers.

Frequently your articles are rather skimpy in giving the full titles of reports by government agencies and congressional committees, as well as the full titles of reports and other documents to which you refer. I'm sure that it would make life much easier for those of us who wish to investigate these issues further if you could give somewhat fuller references in all cases.

Thank you very much for your help.

ERIC GUSTAFSON
Research Associate
Science and Public Policy Program
Graduate School of Public Administration
Harvard University
Cambridge, Mass.

(AVIATION WEEK is glad to comply with this request and any others that will make it more useful to its readers.—Ed.)

Six-Bladed Rotor

On p. 31 of the July 25 issue of AVIATION WEEK there appears a picture of the Westland Westminster helicopter decked out in its new fuselage covering. The caption beneath the picture mentions that the Westminster's rotor is a four-blade version. The four blades in view appear to be much less than 90 deg. apart. Are there more blades hiding out on the opposite side of the fuselage?

H. E. DICKARD, JR.
San Diego, Calif.

(*Reader Dickard is correct. The four-bladed rotor is an earlier version and the Westminster now carries a six-blade rotor [see AW Aug. 22, p. 65].*—Ed.)

Eagle Platform

In your Aug. 1 issue (p. 33) I believe that there has been a mistake in listing the aircraft that Adm. J. T. Hayward said the Navy had considered as launchers for the Eagle. You state that the Grumman W2F was among those under consideration. As far as I know, the W2F is to be a Navy AEW aircraft and not capable of launching missiles. Could it be that you meant to say the Grumman A2F Intruder?

I thoroughly enjoy each issue of AVIATION WEEK and look forward to it every week.

BARRY A. MILLER
Milan Arsenal
Milan, Tenn.

(*The turboprop Grumman W2F was under consideration as an Eagle launching platform before the Navy decided to order the Douglas Missileer as the Eagle launcher.*—Ed.)

Convair's F-106A Delta Dart all-weather interceptor holds the world speed record of 1525 miles per hour.* It is now operational with the U.S.A.F. Air Defense Command.

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*Established December 15, 1959, Edwards Air Force Base, California, record photographed and tracked by [illegible] the National Aeronautic Asso[illegible]